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EVALUATING THE IMPACT OF PRICE INCENTIVES ON ADOPTION OF TECHNOLOGY AND PRODUCTION PATTERNS IN THE ONTARIO WHEAT INDUSTRY

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List of Acronyms

ASA	Agricultural Stabilization Act
CEWW	Canada Eastern White Winter
CRAM	Canadian Regional Agricultural Model
CWB	Canadian Wheat Board
CWRS	Canada Western Red Spring
EC	European Community
GATT	General Agreement on Tariffs and Trade
HRSW	Hard Red Spring Wheat
HRWW	Hard Red Winter Wheat
IME	Industrialized Market Economies
MTN	Multilateral Trade Negotiations
OECD	Organization for Economic Cooperation and Development
OMAF	Ontario Minister of Agriculture and Food
OWPMB	Ontario Wheat Producers Marketing Board
RHS	Right Hand Side
SCGP	Special Canadian Grains Program
TPWP	Two-Price Wheat Program

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Executive Summary

The Ontario wheat industry was, until 1986, characterized by the production of soft white winter wheat. As of 1986, Ontario producers, in response to price incentives increased their domestic market share; by developing and adopting new varieties of hard red spring wheat especially suited to the needs of the milling industry. The area planted to hard red spring wheat was expanded at the expense of soft white winter wheat, barley and corn. Hard red spring wheats used to make bread have been traditionally supplied by Western Canada.

This paper examines the extent to which price incentives through the two price wheat policy introduced distortions into the Ontario wheat industry by increasing hard red spring wheat production. A linear programming model of the Ontario wheat industry was developed. The results reflect the assumptions imposed in the model and relate to the use of historic cropping ratios, production costs, yields and relative profitability, as well as the proportion of wheat that goes into the feed and food market.

The results indicate that the price incentives had

significant effects, promoting technological adaptation in the red wheat industry in Ontario and encouraging the cultivation of hard red spring wheat in most Ontario regions at the expense of soft white winter wheat and other crops. Currently, Ontario exports two-thirds of the winter wheat it produces on a competitive basis. Changes in production patterns also shift Ontario's trade patterns, in that less winter wheat is exported into the world market and less hard red spring wheat is imported from the west.

The removal of the two price wheat program will cause regional shifts within Ontario where red wheat is grown. Central Ontario seems to have some comparative advantage in growing red spring wheat over winter wheat at 1986 world price levels. This implies that there will be some regional shift in production patterns from the Western crop region, where most of the red wheat was grown in 1986, to the Central region. However, the results indicate that the overall acreage seeded to hard red spring wheat without price incentives will not increase beyond the 1986 acreage based on market prices reflecting 1986 levels.

Introduction

The marketing of wheat produced in Ontario is handled by the Ontario Wheat Producers Marketing Board (OWPMB). Ontario is a net exporter of soft white winter wheat. The other important varieties of wheat grown in Ontario are the hard red spring and the hard red winter wheat used in the domestic market. The price of wheat sold in the domestic market was established by the Two-Price Wheat Program (TPWP) from 1967 to 1988. The export price is the result of competitive world prices.

Canadian producers are not isolated from world price movements. Depressed world grain prices in 1986 were the result, at least in part, of policy instruments and programs put in place to support, protect and stabilize domestic agricultural sectors especially in the US and EEC. High support prices maintained by domestic agricultural policy have encouraged production. This has led to a situation of excess capacity given the relatively slow growth in domestic demand. More food and other agricultural products are being produced than the market wants, at least at prices that cover costs of production.

This study evaluates the role that could have been played by

the TPWP in expanding the production of hard red spring wheat (HRSW) in Ontario if it had been maintained. It examines the impact that pricing policy can have on the introduction and adoption of new technologies such as improved varieties of wheat. Further, this analysis explains how the increase in the production of HRSW changes the production patterns in Ontario and affects producers' income, and interprovincial and international trade.

This paper is organized as follows. Section I provides a brief description of the Ontario wheat industry. This provides a background against which the TPWP can be evaluated. Section II describes the conceptual framework and the linear programming model developed for the analysis. Section III discusses the data used in the analysis. Section IV presents the results, examines the impact the TPWP has had on domestic production and trade, and looks at what might have happened if it had been maintained. In Section V, the conclusions are presented.

Part One: The Ontario Wheat Industry

The Ontario wheat industry, like the overall domestic wheat industry, is characterized by a high degree of government involment providing stability and support for wheat producers through a marketing board -the Ontario Wheat Producers Marketing Board (OWPMB). This Board is empowered under provincial legislation to act as the sole agency for marketing wheat produced in its respective region (Ontario). The Board's primary goal is to maximize producer returns from sales of grain delivered to them.

An important feature of this market, until recent changes[1], has been the fact that the domestic milling industry has been restricted to Canadian sources for wheat and other cereal grains. This is made possible by import licensing provisions given to the CWB. The CWB does not, in general, allow imports. This combination of closed borders, marketing board control over domestic supplies and the Two-Price Wheat Program (TPWP), as discussed in detail later, allows domestic prices to differ from world prices.

[1]This feature is afected by Canada-US Trade Agreement and recent revisions to the TPWP.

Wheat delivered to the OWPMB is composed of various varieties and grades. In order that a fair and equitable return be provided to producers from the different markets, the Board established four pools in 1986: pool "A" for white milling wheat (the cake, pastry and cereal market); pool "B" red milling wheat (the cracker and bread market); pool "C" utility red milling wheat for export flour and product use; and pool "D" Canada feed for feed grade wheat.

On delivery of wheat, producers receive an initial payment, guaranteed by the federal government from which a license fee of $1.00 per tonne is deducted to cover OWPMB administration costs. In addition to the initial price, the Board pays interim and final payments directly to producers when market returns (less Board costs) exceed the initial payment.

Canada Eastern White Winter Wheat

(i) Production

The production of wheat in Eastern Canada is small relative to wheat production in the Prairie Provinces, as shown in Table1.1. The majority of wheat produced in Ontario is soft white winter wheat, referred to officially as Canada Eastern White Winter (CEWW). It is preferred by the processing industry for cakes, pastry, and breakfast cereal, in part due to the lower

protein content of CEWW compared to other wheats. Production of CEWW wheat has grown since 1981.

Table 1.1
Canada Eastern White Winter Wheat (CEWW) and Canada Western Red Spring Wheat Production (CWRS), 1981 to 1987.

	Eastern Canada		Western Canada	
Year	All Wheat	CEWW	All Wheat	CWRS
		(Millions of tonnes)		
1981	.733	.709	23.835	20.548
1982	.377	.353	26.181	22.861
1983	.804	.776	25.596	22.562
1984	.828	.797	20.222	17.674
1985	.996	.954	23.046	20.387
1986	1.031	.947	30.144	25.256
1987	.634	.484	25.090	20.384

Source: Statistics Canada, Publications 22-002.

Table 1.1 illustrates the tremendous variability in production of CEWW wheat that can occur depending upon prevailing planting and growing conditions as well as prices. In 1981 a good quality CEWW crop was harvested and was approximately 95 per cent grade # 2. In 1982, crop production declined to 353 thousand tonnes. Seeded acreage fell because of a wet fall and late harvest in 1981 that resulted in the 1982 crop being planted in less than ideal conditions. Surveys conducted by the OWPMB also indicated a high percentage of winterkill in 1982 due to extreme

cold and icing when snow cover was minimal. The last time the Ontario winter wheat crop suffered such severe winterkill damage was in 1978 when approximately 35 to 40 per cent of the crop was lost. From 1983 to 1986, the production of white winter wheat in Ontario increased at a steady rate, due to yield improvements. During this period the overall quality of the crops was good, with minimal winterkill. Production in 1987 declined by 50 per cent from 1986 due to lower world wheat prices and reduced seeding in the fall of 1986 caused by wet weather conditions. It is estimated that total area seeded for soft white winter wheat was about 131,523 hectares in 1987 compared to 252,929 hectares for the 1986 crop.

(ii) Marketing

The OWPMB is the sole marketer of wheat produced in Ontario. Domestic and export sales, average gross unit returns from each of these markets, and the pool price return to the producer are reported in Table 1.2 for 1979 to 1986. Total domestic sales and gross return includes domestic milling, feed and seed wheat sales. Marketing costs incurred by the pool are a blend of the costs in the domestic and export markets. Nearly 75 per cent of the pool marketing costs result from agent handling fees, terminal elevation, truck transportation and carrying costs.

Table 1.2
White Winter Wheat Marketings by OWPMB

Crop Year	Export Sales		Domestic Sales		Total Sales	Marketing Cost/T	Pool Price/T
	(Tonnes)	($/T)	(Tonnes)	($/T)	(Tonnes)	($/T)	
1979	419000	167	239000	181	658000	26.91	148
1980	349000	164	**316000	215	665000	32.74	164
1981	432000	177	232000	218	664000	36.89	157
1982	152000	131	165000	204	317000	40.23	*130
1983	461000	157	287000	207	748000	31.05	146
1984	546000	168	244000	221	790000	30.93	154
1985	576000	151	280000	239	856000	41.21	143
1986	577000	108	327000	227	904000	39.58	110

Source: Ontario Wheat Producers' Marketing Board.
Notes: * plus federal stabilization payment
** includes 76000 tonne of feed wheat sold domestically
The total volume and gross return includes domestic milling wheat, feed and seed wheat sales.

Over the 1979 to 1986 period an average of 38% of total sales (261,250 tonnes) were made in the domestic market. The remaining portion of CEWW was exported, averaging 439,000 tonnes over this period. Over the past eight years, domestic consumption of wheat has remained relatively constant in Canada at roughly 80kg per capita and significant growth is not anticipated in the near future. With production increasing, a larger percentage of CEWW will be exported, with the result that the world wheat market will play a more dominant role in determining the dollar return to producers.

Red Wheat

Red wheat has always held the interest of Ontario wheat producers. In the past, hard red spring wheat has been grown for feed use. Since 1983 significant interest has been shown in growing hard red spring and hard red winter wheat for the higher valued domestic milling market. Ontario bread flour processors normally grind spring wheat as opposed to red winter wheat. If a good quality hard red spring wheat could be developed and produced in Ontario to compete with western red springs, there is an expectation that such a wheat would gain an increasing share of the higher priced domestic market. However, solid enduring tests are required before the domestic processors will be convinced that they can substitute Ontario grown hard red wheats for similar wheats now grown in Western Canada.

In 1983 the OWPMB marketed hard red winter wheat through the existing white wheat pool. In 1984, with a growing interest in the production of red wheats, the Board established a separate Identity Preserved pool for Monopol hard red winter wheat. In the 1985 crop year, the major issue was the establishment of a three pool system, extended to four pools in 1986, in order to maintain an equitable system for all producers across the province and to continue with the identification of wheat in terms of its true marketable value.

For the 1987 crop year the four pool system was maintained, but with the increased production of red wheat in Ontario, the OWPMB amended the Pool B red milling wheat category. The red milling wheat pool was divided into three subpools: subpool (1) consists of western red springs; subpool (2) for Max red spring; and subpool (3) for Monopol red winter wheat. It was reported in the OWPMB Annual Marketing Report (1987) that subpooling will continue for Pool B for the 1988 crop.

Monopol is a blend wheat. The mills buy this wheat to blend with high quality western wheats to keep costs down. Monopol is produced in Ontario under new, high cost, intensive cereal management practices and is presently being used as a filler wheat at a 5 to 15 per cent blend. To support Ontario wheat producers, processors experimented with the 1984 and 1985 crops of Monopol to find products that could be made using this wheat. The sales success of the 1984 crop as well as the 1985 crop of red wheat was due in large part to the co-operation of the mills in buying Monopol and Vuka with which to experiment, rather than due to quality of the wheat itself. The bread market potential for red winter wheat would appear to be in a range of 15,000 to 30,000 tonnes per annum and the variety Monopol could be a replacement for Alberta red winters now sold into Ontario.

The largest potential for red wheat production lies in the

bread flour market. Over 1.5 million tonnes is ground annually in Canada. To be licensed as a bread wheat, a variety must be equal to or better than the variety Marquis, which is the standard. The most widely used grade of bread wheat is #1 CWRS, 13.5 per cent protein.

Ontario flour processors grind hard red spring wheats as opposed to red winter wheats. This aspect, along with the limited market for red winter wheat and the TPWP discussed in the next section, resulted in a dramatic increase in red spring wheat production in 1986. In Ontario the most widely grown licensed CWRS variety was Katepwa, with some acreage of Columbus and Neepawa. The OWPMB reports (Wheat News: July 1987) that very little is known about the western red springs currently being grown in Ontario, i.e., Katepwa, Neepawa, Columbus, and other licensed CWRS varieties. It appears that red spring wheat was replacing other cereal grains and corn acreage with the development of new techniques and new and better varieties of red wheat appropriate to the growing conditions in Ontario.

The Two-Price Wheat Program

The TPWP was introduced in 1967 to provide a measure of price stability to sales of milling wheat used in Canada by insulating the domestic price for wheat from world prices which are subject

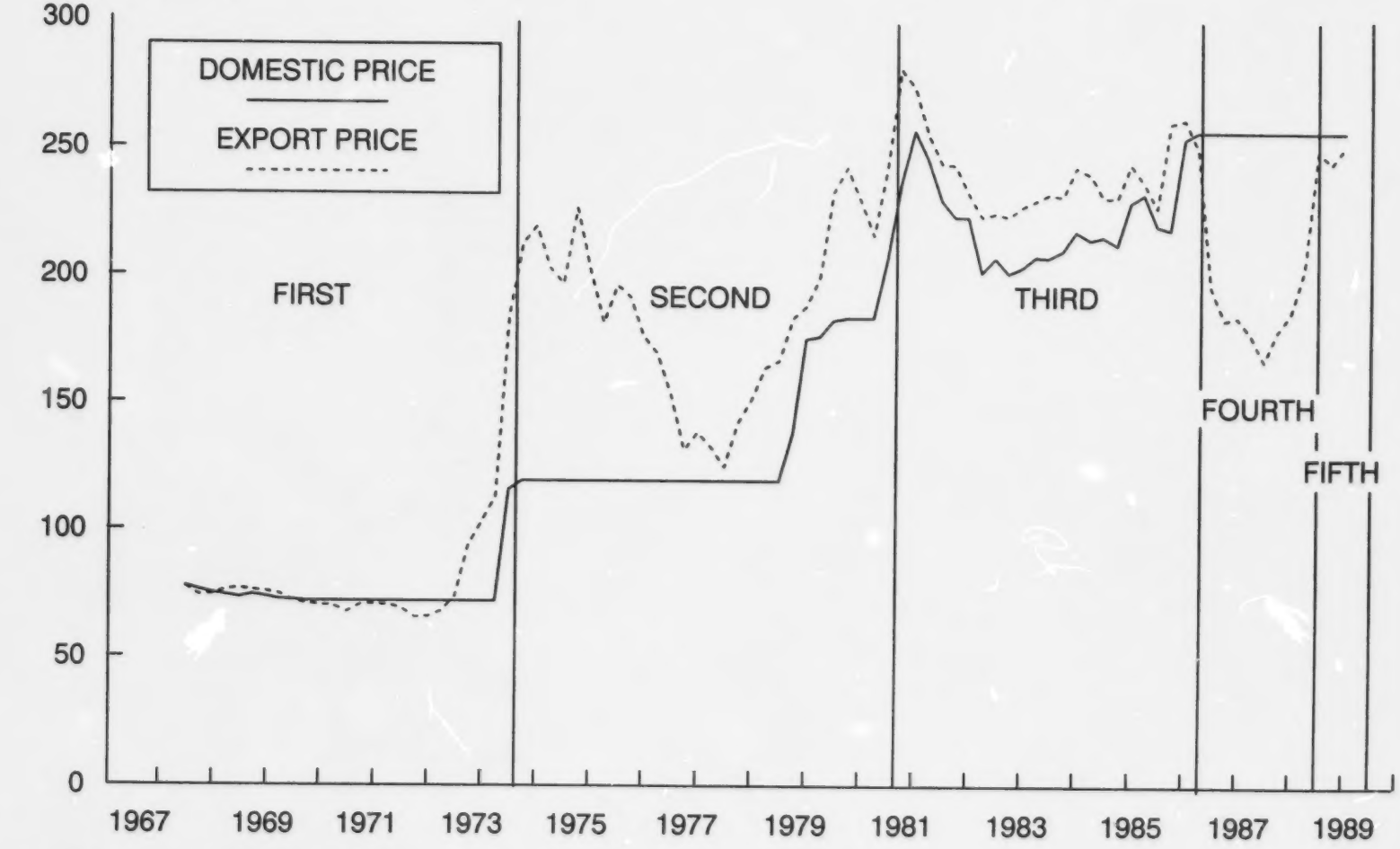
to wide fluctuations. The policy objective was to protect consumers against high world prices and producers against depressed prices.

Figure 1.1 displays the price of No. 1 CWRS, 13.5% protein wheat basis in store Thunder Bay, from 1967 to 1988. The TPWP has gone through five distinct phases since it was first introduced. In the first period (1967-1973) with low world grain prices producers benefited from the Federal Government regulations by $100.1 millions at the expense of consumers ($28.7 millions) and the taxpayers ($71.4 millions) (Grain Matters, Nov-Dec, 1981). For most of the 1967-73 period the domestic price was set at $71.83/T.

In the second period (1973-80) consumers benefited by $493.5 millions, which was subsidized by the taxpayer at a cost of $401.2 millions and by transfers from producers ($92.3 millions). The domestic price was set at $119.42/T and as world price was considerably higher the government paid a subsidy on domestic sales equal to the difference between the average export price and $119.42/T up to a maximum of $64.30/T. When the export price rose above this maximum, producers subsidized consumers.

The third period (1980-1985), saw a slight transfer of income from producers to consumers of $4.7 million as world wheat prices

FIGURE 1.1 THE TWO-PRICE WHEAT PROGRAM PERIODS



SOURCE: STATISTICS CANADA

moderated. In this period the domestic price was allowed to fluctuate between a minimum of $183.72/T and a maximum of $257.21/T.

The overall balance for the 1967 to 1985 period indicates that the federal government paid out $472.6 millions, which yielded benefits of $469.5 millions to consumers and $3.1 millions to producers.

In the fourth period of the policy (April 1986 - August 1988), with the collapse of world grain markets, the policy changed because of the need to increase returns to Canadian producers. For the 1986/87 crop year the export price for No. 1CWRS was $133.38/T. The CWB maintained the domestic price to millers at $257.21/T.. The difference between the domestic price and the world price has been paid by consumers. There has been a transfer of income to producers, in this period (1986 to present), of approximately $248 million per year (based on 2.0 million tonnes consumed domestically at $257.21 a tonne).

During the fifth period (effective only for the 1988/89 crop year), the difference between the export price based on the North American Market and the $257.21/tonne will be paid to wheat producers through a government subsidy. After August 1, 1989 the TPWP will be terminated.

Other Implications of the TPWP

This policy has had several other impacts. First, with a large price difference between U.S. and Canadian wheat prices, the TPWP has a negative impact on the competitiveness of Canadian millers since the domestic processors of wheat must purchase their raw materials from the Wheat Boards, sometimes at prices set considerably above world prices. Faced with high raw product prices, the Canadian processing industry is less competitive in both domestic and international markets. In recent years, the Canadian milling industry has lost some domestic markets to imported retail packs of baked goods because domestic wheat prices have increase significantly while international wheat prices have decreased. This trend is particularly evident in British Columbia, where an estimated 20 percent of the Vancouver retail bread market is now supplied from the United States[1].

Second, higher domestic wheat prices encourage the production of wheat at the expense of other commodities such as coarse grains and oilseeds, which could result in a misallocation of resources.

Third, some wheat producers will benefit more than others. Eastern producers derive a relatively larger per unit benefit

[1]Industry Profile. Flour Milling. Industry, Science and Technology Canada. 1988.

from the TPWP as their sales to the domestic market account for a relatively large portion of their wheat sales (28% compared with 8% in the West). Western producers do not receive as large a "per tonne" benefit as that obtained in Eastern Canada, but since they sell much more wheat domestically they receive a larger absolute benefit.

Fourth, it affects other policies, since the domestic price of wheat has an effect on the Initial Payments and pool deficits, WGSA and ASA programs. In periods of high domestic prices the TPWP will reduce the size of payout from these stabilization and support programs.

Part Two: Conceptual Model

In 1986 producers delivered to the OWPMB 93% of total production: 36% was marketed for domestic consumption at $227.08/Tonne for CEWW and $221.39/Tonne for red wheat, and 64% was exported at $107.50/Tonne. Total domestic human consumption was 2.1 million metric tonnes in 1986, of which Ontario wheat producers supplied 18%, and Prairie wheat producers supplied around 75%, mostly CWRS used in the bread market plus some soft wheat and durum. The model assumes that total domestic human consumption is ditributed based on population -the eastern Canadian domestic consumption is therefore about 70% of this total.

With the TPWP, the 1986 price of wheat sold domestically was maintained higher than that for export wheat. This will encourage increased production in the red wheat market since Ontario wheat producers are not restricted and they have the incentive to gain a larger share of this market. In 1986 and 1987, production of HRSW increased by 100% and 79%, respectively, as presented in Table 2.1.

The thrust of this analysis is that growth in Ontario red wheat production has been encouraged beyond what it would have

Table 2.1
Ontario Production of Winter and Spring Wheat. 1960-1987

Year	Winter Wheat	Spring Wheat
	('000 tonnes)	
1960	478	11
1961	544	13
1962	428	13
1963	479	15
1964	492	15
1965	356	16
1966	409	18
1967	421	10
1968	406	8
1969	390	7
1970	424	7
1971	383	12
1972	432	13
1973	403	11
1974	519	11
1975	610	16
1976	668	16
1977	843	19
1978	374	19
1979	688	24
1980	712	23
1981	709	24
1982	354	24
1983	776	27
1984	797	30
1985	955	42
1986	947	84
1987	483	150

Source: Agricultural Statistics for Ontario, OMAF.

been in the absence of the TPWP. In 1986 and 1987, red wheat farmers in Eastern Canada, whose major market has been the domestic market, have been sharply increasing their production of HRSW to take

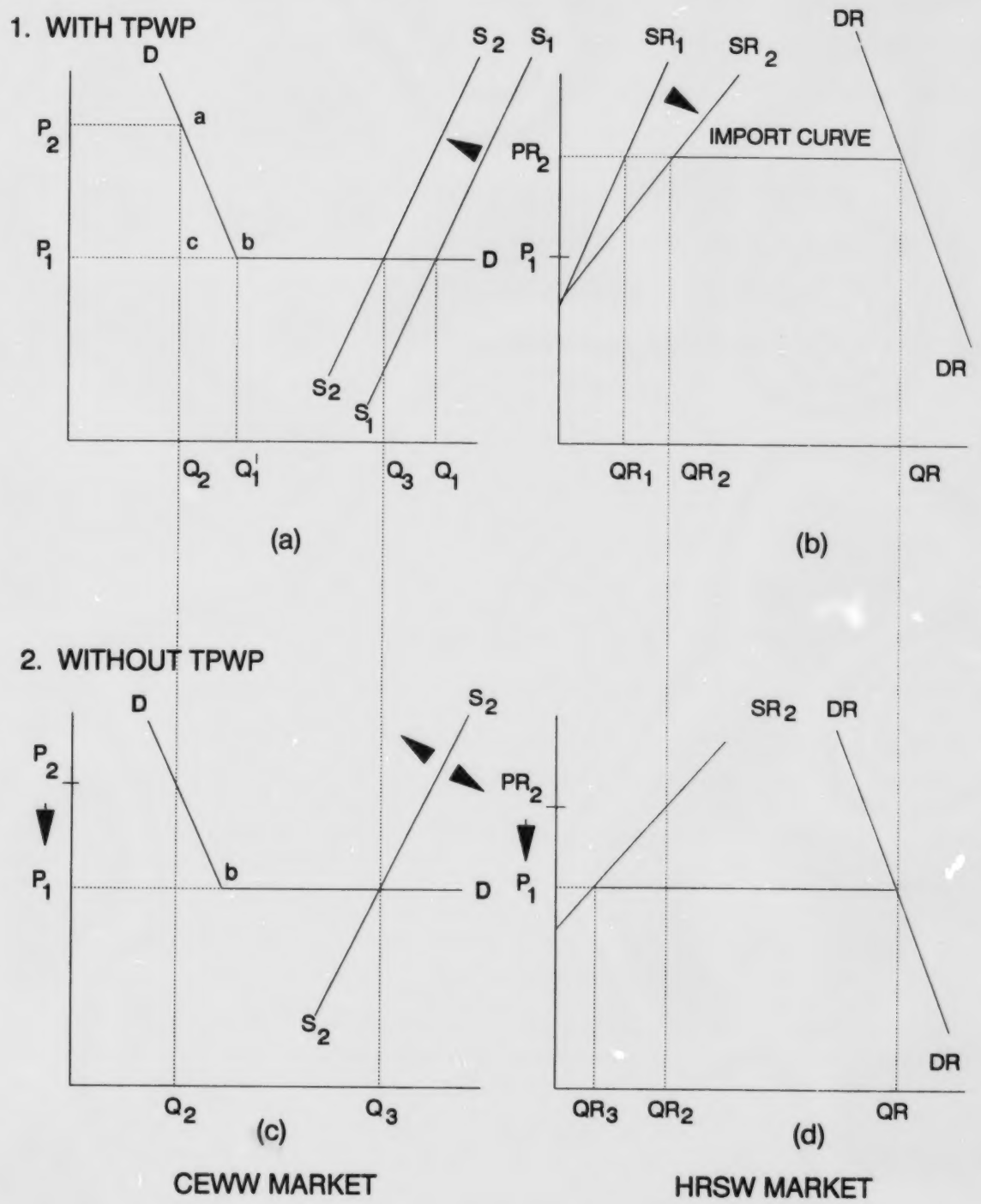
advantage of the higher domestic price. The impact of this policy incentive is shown through the development and adoption of new technology in the Ontario red wheat industry. New strains of red wheat have been developed to suit the Ontario growing conditions. Any increase in the Ontario share of the red wheat domestic market will have a negative impact on shipments of #1CWRS from the Western Canada. In the following paragraphs, a conceptual model of this analysis is presented

Conceptual Model

The conceptual model is developed along a regional basis. To study how wheat production patterns change as a result of the TPWP pricing policy and adoption of new technology, the total Ontario wheat market is broken down into two separate markets: CEWW and red wheat markets. It is reasonable to view the wheat market as differentiated because the end uses are different and substitution is very limited.

In Figure 2.1(a), the demand for CEWW wheat is kinked at the export price being represented by DbD. The domestic quantity demanded is highly inelastic in the Db portion of the demand curve but the export demand faced by Ontario wheat producers is perfectly elastic at price P1 (the world price). In panel (a) supply is displayed by the curve S1 for CEWW and in panel (b) by

FIGURE 2.1 IMPACT OF THE TPWP ON THE ONTARIO WHEAT INDUSTRY



SR1 for red wheat. The total soft white winter wheat production in Ontario is Q1. In a competitive market situation free of policy interference, the world price P1 would prevail in the domestic market. However, the TPWP sets domestic price at P2. The amount Q2 is consumed in the domestic market at the higher domestic price P2 and the amount (Q1-Q2) is exported at the price P1. The quantity Q2Q1' indicates the amount shifted from the domestic to the export market because of the policy. Total quantity produced does not change with the introduction of the TPWP as, at the margin, producers still respond to P1, the export price[1]. Figure 2.1(a) indicates that the producers welfare gain is P1P2ac, domestic consumers lose P1P2ab, with abc representing a net welfare loss to the economy.

In Figure 2.1(b) the supply and demand curves for red wheat in Ontario are presented. Domestic demand (DR) is assumed to be inelastic. Initially at price PR2 under the TPWP, the Ontario supply is QR1 and (QR-QR1) is the supply of wheat from western Canada. The TPWP will have a much different impact on the red wheat market compared to the white wheat market. Ontario producers of red wheat would receive the high price (PR2) on additional output up to QR, a price much higher than P1 for exported white wheat and higher than prices for alternative field

[1]The effect of pooling is ignored. Refer to Appendix A for a discussion of how the model could be modified to take pooling into account.

crops such as corn, barley or soybeans. To take advantage, they can adopt new technology to improve on yields and grades, and they can also adopt new varieties of CWRS wheats as discussed earlier. The high profits anticipated under the TPWP encourage eastern producers to adopt new varieties of HRSW that will enable producers to compete with the CWRS wheat for use in the domestic market. This has the effect of shifting the supply curve to the left from SR1 to SR2 increasing production from QR1 to QR2 (or further as all farmers adjust to the new information). While increased production will not affect the price received, it will reduce import demand, impacting negatively on western producers. Since CEWW and red wheat compete for the available land, the supply curve S1 in Figure 2.1(a) shifts to the left, decreasing the production of CEWW wheat which lowers exports, but does not affect the domestic demand. As noted earlier, the acreage of red wheat increased dramatically in 1986 and 1987 as producers responded in part to the incentives provided by the TPWP.

With the phase-out of the TPWP, the domestic producer price declines to P1 (the world price) and output declines along the new supply curve SR2, resulting in the production of QR3 (Figure 2.1d). Since improved production practices once adopted, usually are retained even though the price of the product subsequently declines, farmers are not likely to discard new technologies and thereby shift the supply function to the left once it has moved

to the right. Hence the supply response to a subsequent decline is likely to be less than to the previous increase in price (Tomek and Robinson,1977). Under these circumstances, the response elasticity is higher for a price increase than a price decline (Tweeten and Quance, 1969).

In the CEWW wheat market without price discrimination, the producers now receive P1 (the export price) for their total production. Producers do not reduce production as a result of the lower domestic price of CEWW wheat. They are already responding to the export price since the last unit grown is sold in the export market. Therefore, in spite of declining domestic prices for CEWW, the decrease in the acreage used in the production of red wheat probably will result in an increase in the number of acres in the production of CEWW, shifting the supply curve to the right. On the other hand, producers could decide to increase the acreage of other crops, such as barley or corn if they see that this would be more profitable. In this case the supply curve would then shift to the left reducing the amount of CEWW wheat produced.

The conceptual model raises several interesting questions relating to how price policy can affect production decisions and the adoption of new technology to take advantage of the policy. The response of Ontario producers was just beginning when the

termination of the program was announced. If the program had continued, many speculated that production of CWRS quality wheat would continue to expand, eroding the program benefits being derived by western producers. Besides having a negative effect on the milling industry regardless of the domestic source, if the policy had continued it could have caused the development of a whole industry in Ontario totally dependent on policy rather than on a real comparative advantage.

To test for the impacts the policy could have had, a linear programming model has been developed which investigated the shift to red wheats with and without the TPWP. The structure of this model is presented in the following section.

Structural Characteristics of the Model

The Ontario Crop Model is part of the Canadian Regional Agricultural Model (CRAM), which is a static, annual linear programming model. CRAM (Weber et.al.,1986) is composed of seven provincial groups: Alberta, Saskatchewan, Manitoba, British Columbia, Ontario, Quebec and the Maritimes. The first three provinces are modeled at the crop district level and each of the other seven provinces are modeled as a single crop region.

To test for the reactions discussed above, it was necessary

to disaggregate the Ontario block to the crop district level. The CRAM model does not employ a methodology that incorporates supply elasticities directly, in part because little empirical research has been carried out at the subprovincial level. In its place, the model employs alternative cropping mixes within each region, selected on the basis of relative profitability between crops, and then the provincial level response is determined by aggregating from the regional level.

The purpose of this section is to present a brief overview of the development of the Ontario crop component[1]. It is a single period model with 1986 chosen as the base period. Cash costs of production and product prices are given exogenously, as it is assumed that Ontario will not affect either. The problem is to determine the level of agricultural production activities which maximizes the objective function subject to constraints facing the production sector. The Ontario crop model contains approximately 188 activities and 150 constraints. The objective function is defined in terms of net revenues (market prices less cash costs of production and transport costs).

The Ontario crop block of the model has been developed by disaggregating the province into five crop districts or regions:

[1] For the purpose of this study, only the Ontario block, plus relevant trade relationships have been included in the model. The results would not have changed by employing the whole model

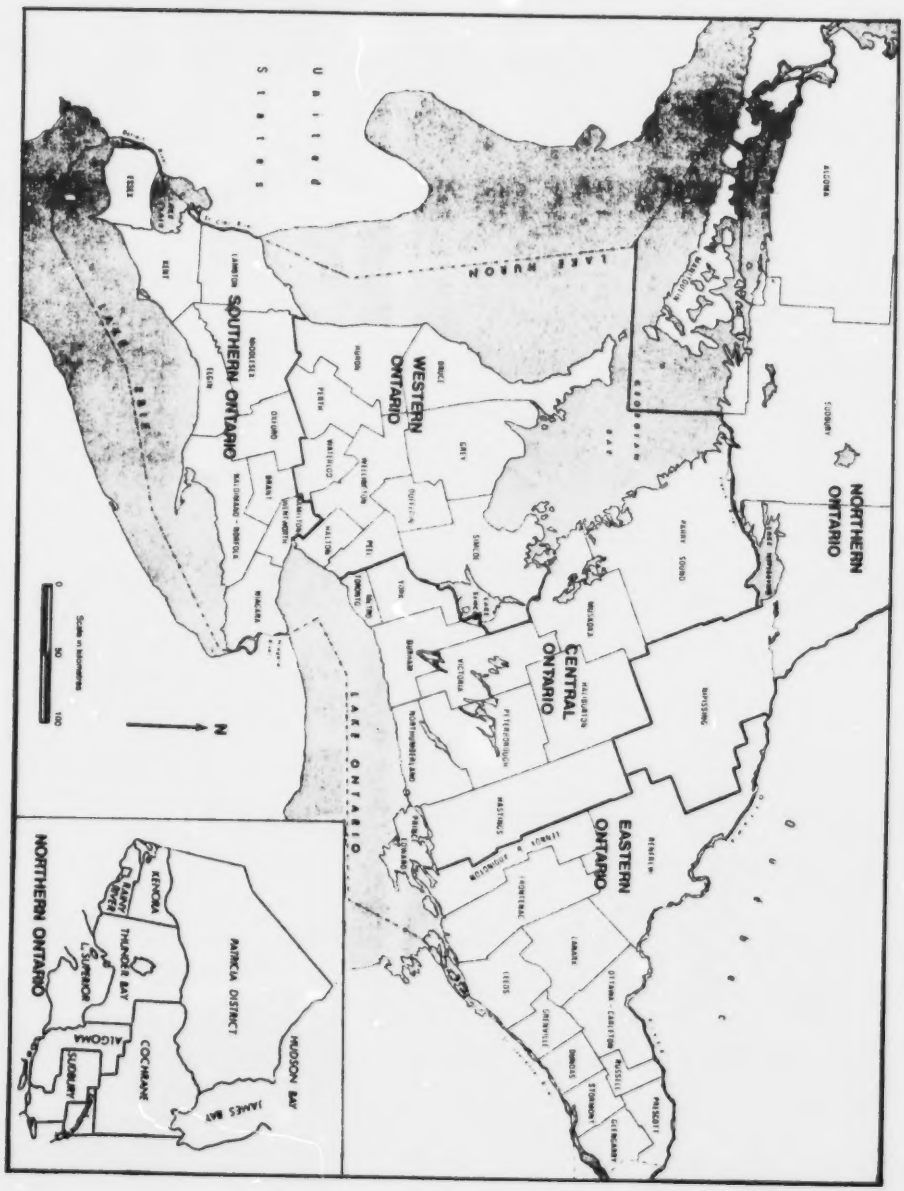
South, West, Center, East and North (Figure 2.2). Wheat is disaggregated into two production activities (winter and spring wheat) producing four types of wheat (CEWW, HRSW, HRWW and feed) that face three demands activities for bread, pastry and feed wheats. This disaggregation of the model is required to study the response of the supply of wheat in Ontario to different price policies, this being one of the objectives of the analysis. The other principal crops are barley, soybeans, corn, forage crops, pasture and other crops.

The structure of the model may be explained through the following three sets: i) production, ii) trade or transportation, and iii) domestic demand.

i) The production activities of the model are related with crop and forage production and with four sets of livestock (beef, dairy, hogs and poultry). Crop and forage production are disaggregated to the regional level while livestock are modeled at the provincial level. Livestock production is connected with crop production through demand for feed grain, which is a function of the number of animals. This is an important element in the determination of the domestic demand for feed grain in the Ontario model.

ii) The trade block in the model incorporates both

FIGURE 2.2 ONTARIO CROP DISTRICTS



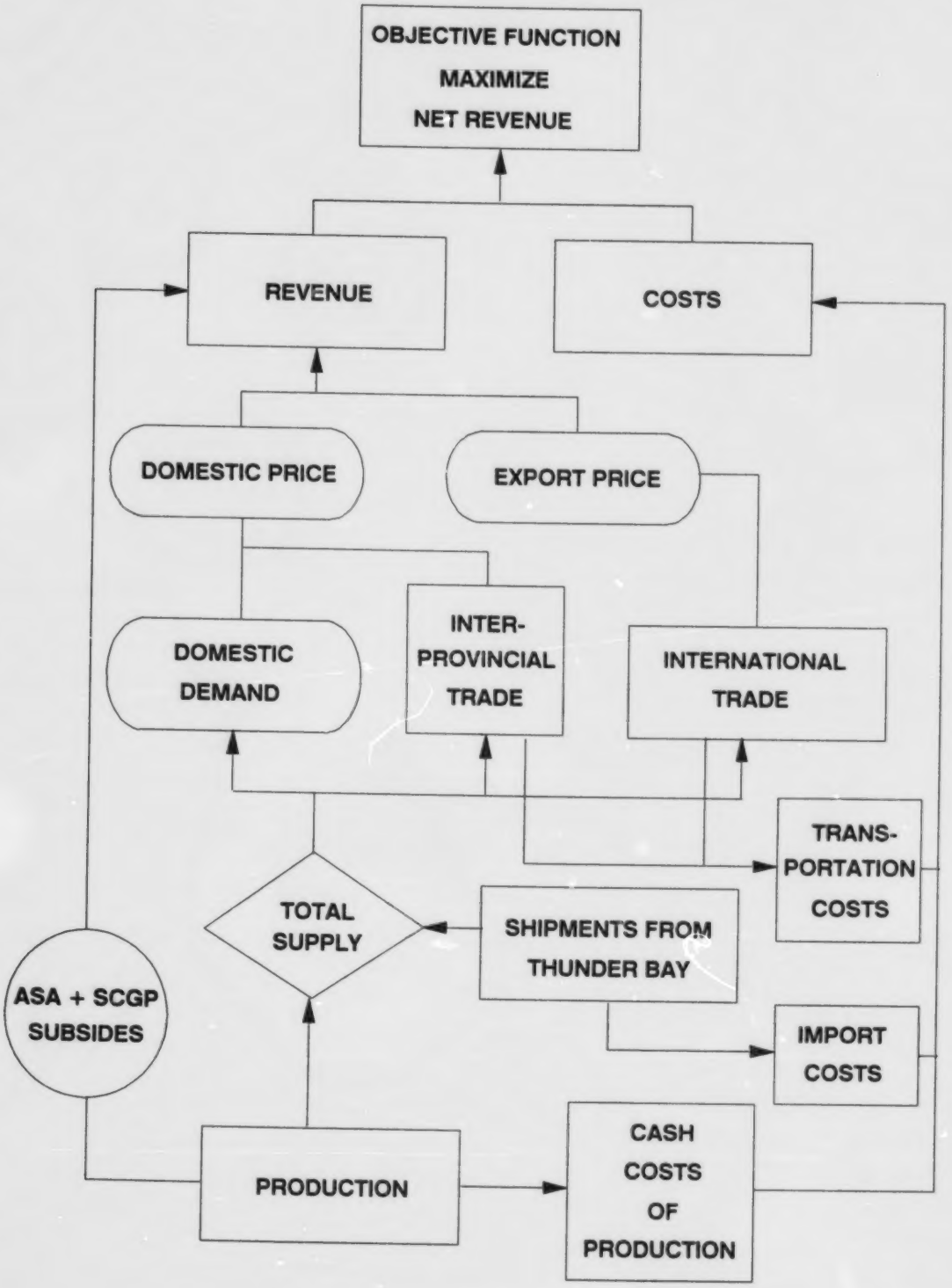
interprovincial and international trade. Grain is shipped from production regions to the provincial level where domestic demand is modeled. Transport activities also allows for the movement of grain to Quebec, the Maritimes and the export market. Imports from Western Canada can also occur. With respect to inventories, the level of opening and closing commercial stocks of grains are assumed constant in the model.

iii) The demand for wheat in Eastern Canada is exogenously fixed since food demand for wheat is relatively price inelastic. From 1979 to 1986, per capita consumption of wheat, whether red or white remain relatively constant with no indications of significant growth.

Figure 2.3 illustrates the general structure and the logic of the model[1]. The objective function is to maximize net revenue. Revenue is obtained from the sales of the Ontario crop production in the domestic and export markets at the corresponding prices and from payouts under the Agricultural Stabilization Act (ASA) and the Special Canadian Grains Programs (SCGP). The model allows for shipments of grains from Thunder Bay when the production does not meet the domestic demand. The cash costs incurred in the production and shipment of grain to other provinces and

[1] The linear programming tableau presentation of the structure of the model is discussed in detail in Appendix B.

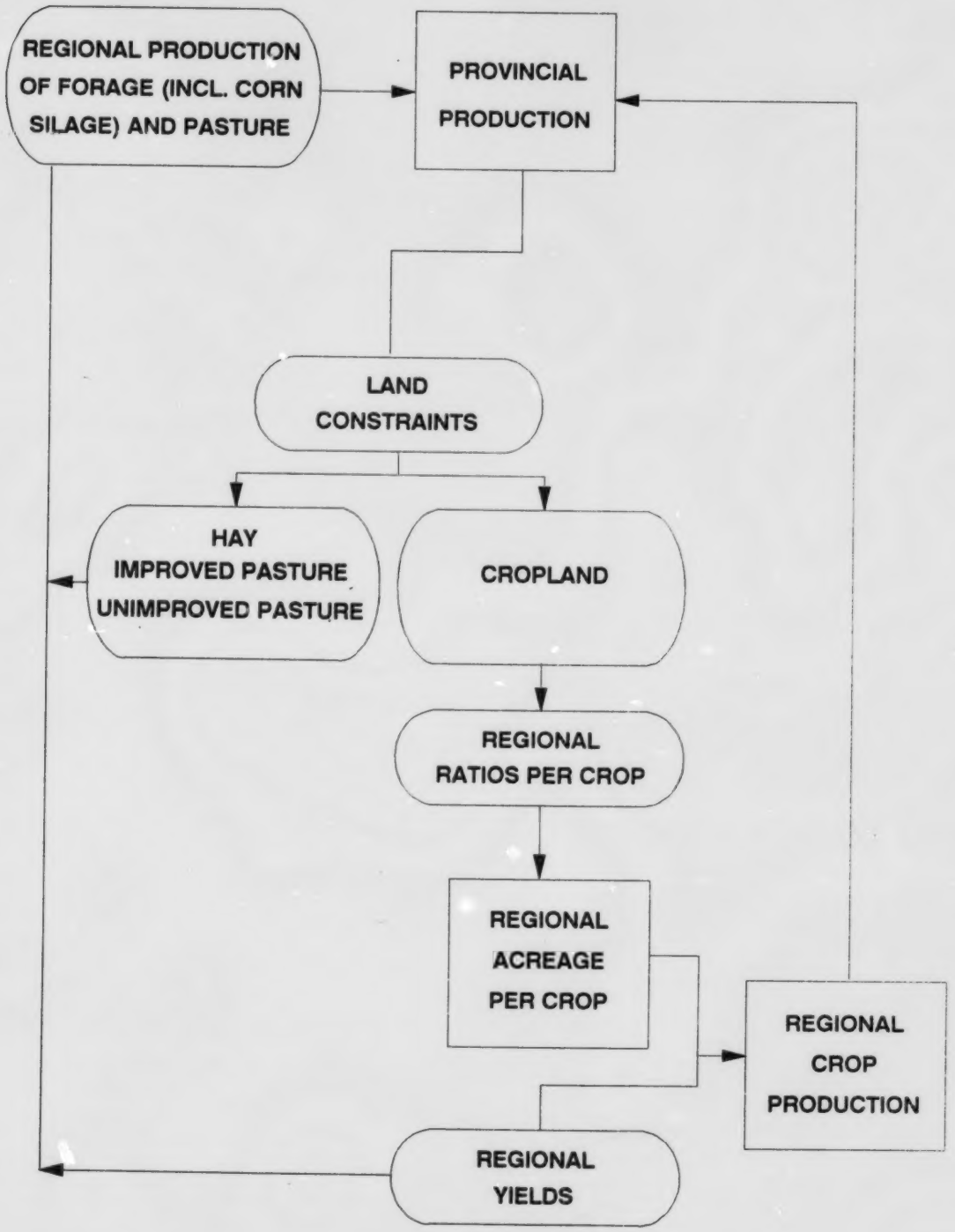
FIGURE 2.3 GENERAL STRUCTURE OF THE ONTARIO CROP MODEL



to the export ports are deducted from the revenues. The shipments from Thunder Bay are entered in the model in the same way as costs and cancels out when the grain is sold to meet domestic demand, leaving the net revenue of the Ontario crop sector unaffected.

Figure 2.4 presents the structure of the crop production block of the model. Provincial production is the accumulation of production from the five regional levels that will be used at the domestic and export levels. Regional production is constrained in the model by the available land. There are four types of land in the model: cropland, land in hay, land in improved pasture, and unimproved pasture. Regional acreage per crop is determined by the set of crop ratios that specifies the allowable mix of crops in a region. These ratios relate to actual crop mixes in the past. The selected crop mix is the one that maximizes the return to producers. The resulting acreage together with the corresponding crop yield coefficient determine the production per crop at the regional level.

FIGURE 2.4 STRUCTURE OF THE PRODUCTION BLOCK



Part Three: Empirical Model

The activities in the model can be divided into production, shipping, and marketing activities. The data requirements of each of these blocks are summarized in Table 3.1

Table 3.1
Summary of Data Requirements in the Model

1.	Production sub-matrices:	Crop (by district) . land available . crops grown . cropping ratios . cost and yield data
2.	Shipping sub-matrices:	. commodities shipped . shipping routes by commodity . unit shipping costs by route
3.	Marketing sub-matrices:	. domestic demand levels . SCGP and ASA subsidies . commodity prices.

In general, 1986 was taken as the base year for coefficients in the model. In using actual 1986 realized prices a very naive assumption is being made that producers could accurately forecast actual market prices and government payments at planting time. Since this experiment is mainly interested in the medium term impact that relative price changes could have on production patterns, this is not felt to be a serious limitation. Average yields are used rather than actual 1986 yields as producers at

planting time would make their decision on expected yields and relative prices. Yields could vary substantially due to weather, but this cannot be controlled by producers.

Cash Cost Data

The cash cost data for Ontario crops are presented in Table 3.2 These data are taken from OMAF report 86-02 (1986). The crops listed in columns 1 to 6 constitute uses of cropland, while columns 7 relate to tame hay land. The set of crops and the cash costs specified in Table 3.2 are the provincial estimates and are assumed to be the same for all crop districts in Ontario. Cropping practices and costs are assumed to be relatively standard for all the regions.

Table 3.2
Cash Costs Data for Ontario

	W.W	S.W.	Barley	G.C.	Soy	F.C.	A.H.
			($/acre)				
Fertilizer	37	30	28	43	18	41	27
Chemicals	2	6	2	32	26	32	3
Fuel & Repairs	30	24	30	29	31	21	27
Wages	1	3					
Other	31	48	23	90	35	79	29
Seed	19	32	14	24	20	21	10
Insurance	2	1	5	7	6		7
Interest	7	4	4	9	5	8	4
Misc.	4	11		50	4	50	8
Total ($/acre)	101	111	83	194	110	173	86
Total ($/ha)	251	274	205	480	272	428	213

W.W. - Winter Wheat, S.W - Spring Wheat, G.C. - Grain Corn, F.C. - Fodder Corn, A.H. - Alfalfa Hay.
Source: Grain and forage crops estimated production costs. Ontario, 1986. OMAF, report No. 86-02.
Notes: the total cash costs data used for tame pasture and unimproved land, not included in the table, are $59 and $18 per acre.

Yield Data

In Table 3.3, there is one yield datum for each crop grown in each district in Ontario. Yields for all crops are based on the 1981 to 1986 average area and production (Appendix C). However, for this analysis further disaggregation of wheat yields is necessary to obtain the proportion produced of the four different varieties or grades of wheat that are included in this analysis

because the data required are not available.

To estimate the proportion of grain that is graded feed wheat, it is assumed that the difference between the producer sales from the OWPMB and the total production from OMAF is feed wheat. To this number is added what is sold as feed wheat by OWPMB. This was estimated for just three years, 1984 to 1986. The proportion of winter wheat grading feed wheat quality is 8%.

The proportion of spring wheat grading as feed wheat is assumed to be 60%, which corresponds to 1986. The explanation why the sixty percent was favored instead of the 93%, which is the 1981 to 1986 average, is that in 1986 the grades of the spring wheat improved dramatically to produce the quality of wheat that is comparable to CWRS at 13.5% protein, used in the production of bread. The increase in, and improvement of, red spring wheat demostrates the potential for this type of wheat within Ontario as new varieties are adopted. Sixty percent still represents a large percentage of the spring wheat crop grading feed quality which may improve as experience is gained by Ontario producers. It is used in the model and does represent a significant deterrent to producing this type of wheat.

Winter wheat is the sum of soft white and hard red winter wheats, they are differentiated in the data. The proportion of

HRWW has been calculated using the same approach as for feed wheat. Once again the OWPMB sales have been used to calculate the 1981 to 1986 average proportion for HRWW and what is left is the corresponding proportion for CEWW.

Table 3.3
Yield Data by Districts in Ontario, 1981 to 1986 average.

Crop	South	West	Central	East	North	Province
			(tonne/hectare).			
Winter Wheat	3.377	3.69	3.065	2.814	2.314	3.440
Spring Wheat	3.127	1.814	4.315	2.627	2.064	2.627
Coarse Grains	2.826	3.288	2.826	2.62	2.672	2.980
Soybeans	2.121	1.878	1.697	1.697	2.181	2.060
Grain Corn	6.654	5.900	5.084	5.022	3.139	6.151
Fodder Corn	12.206	11.335	9.591	9.591	8.719	11.335
Hay	8.968	6.726	6.726	6.726	4.484	6.726
O.E.C.($/ha)	5743	1900	4855	3655	2115	3916

Source: see Appendix C
O.E.C.-Other Eastern Crops (Flaxseed,Canola,Dry White Beans, Tobacco, Fruits,Vegetables with yields in $/HA)
Coarse Grains = Barley,Oats,Rye,Mixed Grains,Buckwheat
The yields for wheat, soybeans and coarse grains have been adjusted for seed use and waste (7%).
Fodder corn yield is in tonnes of hay equivalent per hectare (tonne/ha * 35% dry matter content/hay equivalent of .9).

Cropping Ratios Data

Land planted to each crop within a region is constrained by crop ratios, as well as by the overall constraint on the quantity of cropland. The crop ratios are based on data for the six year period, 1981 to 1986. The data for the Southern Ontario crop region are presented in Table 3.4 and a complete listing of crop ratios is provided in the Appendix C. For a given set of product prices, the most profitable crop mix satisfying the regional constraints will be selected by the model.

As noted in Table 3.4, the ratios for winter and spring wheat has not been further disaggregated to include red winter wheat, due to the limits in information available. The OMAF data for winter (or spring) wheat area are the sum of all varieties of winter (or spring) wheat and feed wheat. But through the disaggregation of winter and spring wheat yields, the model estimates the production output for all these wheat varieties or grades.

Table 3.4
Proportions of Cropland Planted to various Crops for Southern Ontario.
(1981-1986)

	Winter Wheat	Spring Wheat	Coarse Grains	Soy-Bean	Grain Corn	Fodder Corn	O.E.C.
1981	0.118	0.002	0.113	0.224	0.394	0.053	0.095
1982	0.054	0.002	0.131	0.280	0.387	0.052	0.094
1983	0.127	0.002	0.105	0.263	0.368	0.052	0.083
1984	0.108	0.002	0.086	0.286	0.394	0.045	0.079
1985	0.104	0.002	0.089	0.290	0.393	0.042	0.080
1986	0.134	0.005	0.093	0.286	0.362	0.042	0.079
82-86	0.105	0.003	0.101	0.281	0.381	0.046	0.083

Source: see Appendix C.

Domestic Demand Levels in Eastern Canada.

In addition to the land constraints, the model is run under the assumption that domestic demand for wheat is perfectly inelastic and is determined exogenously. An upper bound is introduced for the human consumption of HRWW, CEWW, and HRSW in Ontario, Quebec and the Maritimes.

These upper bounds are calculated as follows. First, based on the assumption of a 70/30 population split between eastern/western Canada, the total eastern wheat consumption is equal to 1.47 million tonnes (70% of 2.1[1] million tonnes wheat

[1] Statistics Canada, Cereals and Oilseeds Review, February 1987. Table 1, Supply and Disposition of Wheat, Canada, by Crop Year

used for food consumed in 1985/1986). Second, the distribution between the different wheats is based on the proportion of wheat milled from each wheat. This split is based on Statistics Canada[1] total CEWW wheat milled in 1985/86, which is equal to 224,000 metric tonnes, this amount is substracted from the total eastern wheat consumption and the remaining portion was split assuming 5% blend for HRWW and 95% for HRSW. Third, the provincial distribution of human food consumption of the different wheats has been calculated using the eastern Canada population proportions corresponding to each province. These proportions are: 50% for Ontario, 35% for Quebec and 15% for the Atlantic province. The estimates obtained for the domestic demand levels are presented in Table 3.5.

Table 3.5
Domestic Demand Levels. 1986

Wheat	Ontario	Quebec	Maritimes	Total Human Food
		(tonne)		
CEWW	112,000	78,400	33,600	224,000
HRSW	591,850	414,295	177,555	1,183,700
HRWW	31,150	21,805	9,345	62,300
TOTAL	735,000	514,500	220,500	1,470,000

Source: estimations

[1] Statistics Canada, Cereals and Oilseeds Review, February 1987. Table 3. Selected Statistics of Wheat Products, Canada.

Subsidies and Grain Prices Selected for the Base Run.

Subsidies from the ASA and the SCGP are introduced into the objective function as a separate variable. The sum of the SCGP and ASA (Federal and Provincial) subsidies used in this analysis are presented in Table 3.6. The subsidies for barley are the production weighted average for oats, barley, rye and mixed grains, since in this analysis all feed grains demanded are expressed in barley equivalent.

The domestic prices for wheat are those determined under the TPWP. The price for feed barley is equal to 85% the price of corn ($87.34/T * .85 = $74.24/T) where .85 is the factor for equivalent feed value between corn and barley. In the model corn is converted into barley equivalent and the price of corn is used for feed grains because corn is the most important feed grain crop in Ontario.

Table 3.6
Subsidies and Grain Prices Selected for the Base Run
1986

Crop	Domestic Prices	Export Prices	Subsidies
	($/tonne)		
HRSW	221.39	-	30.45
CEWW	227.08	107.50	46.99
HRWW	221.39	104.00	46.99
FEED WHEAT	115.00	-	30.45
BARLEY (FEED)	74.30	74.30	23.53
BARLEY (FOOD)	120.42	-	23.53
SOYBEANS	242.07	-	27.22
GRAIN CORN	87.34	-	47.10

Sources: Domestic wheat prices are from the OWPMB.
Barley (food), soybeans and grain corn prices are from Agriculture Canada, FARM medium term outlook, January 1988.
Subsidies are from Agricultural Stabilization Board.

Part Four: Model Results

The analysis is comparative static in nature and the simulations represent hypothetical outcomes toward which the sector would tend if prices, or prices and cropping ratios are changed. A comparative static analysis requires a base solution from which comparisons can be made. In this case the model is set up to reflect the situation as it existed in 1986. Against this base, several scenarios are evaluated. One way of interpreting the results is to view them as what the equilibrium situation would have been in 1986 if the changes imposed had occurred in the early 1980's, allowing time for adjustment to occur.

The first scenario, referred to as the "Export Market Price Scenario", simulates the impact of removing the TPWP. This was discussed in Figure 2.1, panels (c) and (d), of the conceptual model. Domestic prices are set equal to world market prices. To test how responsive wheat producers are to price changes, two intermediate levels are also tested representing a 50% and 75% reduction in the domestic price under a reduced TPWP relative to 1986 world prices.

Economic theory, as developed in the conceptual model, also leads one to expect an outward shift in the production of products demonstrating high returns relative to substitutes. In scenario one, some supply response is allowed by the alternative historic cropping ratios. However, in the case of a new crop such as red spring wheat, relaxation of the crop ratio constraints will provide an indication of the extent to which producers would incorporate this new crop into the crop mix. To test how far the supply curve for red spring wheat would shift to the right under a TPWP, red spring wheat and winter wheat are allowed to substitute and then barley is allowed to substitute in scenario two and three. This addresses the specific question of how much imported CWRS might Ontario be willing to replace under a favourable domestic pricing policy.

The last scenario evaluates the potential production and marketing impacts with the elimination of the TPWP, but with the continued ability to adopt red spring wheat at world prices, with substitution between red and white wheat allowed. Comparing scenarios two and four provides an indication of the extent to which adoption of red spring wheat in Ontario may be policy driven or may simply reflect a new technology in which Ontario has a comparative advantage.

Validation

To validate the model, it is set up to reflect the situation as it existed in 1986. Prices, subsidies, production costs, cropland, domestic consumption are set at 1986 levels. The domestic price for wheat is determined by the TPWP at $221.39/tonne for HRSW, $227.08/tonne for CEWW and $221.39/tonne for HRWW (Table 3.6). In Ontario, roughly 40% of total cropland is planted in corn, illustrating the relative importance of this crop. The remainder is seeded to wheat (10%), coarse grains (25%), soybeans (16%) and other crops (9%).

In validating the model, the base line results are compared to actual values in Table 4.1. The difference between the model solution and the actual data is explained by the crop mix for each of the regions that the model selects to determine the regional area planted for each crop. The selected regional ratios are based on cash costs and relative prices for each crop. The difference in production estimates are also due to using six year average yields, instead of 1986 yields, to represent expected or planned production. This optimal crop mix results in slightly lower production of wheat and soybeans and higher production of coarse grains and grain corn. The model results for wheat could be also affected by the price pooling concept (Appendix A) which is not considered in this analysis; the

expected production for CEWW might be higher if producer expectations are based on this average weighted price. Given the limitations and the sensitivity of the parameters, the model closely reflects what did happen and it provides good representation of the Ontario crop sector. An indication of this is displayed when the percentage distribution of actual and model solution values per crop are compared (Table 4.1).

Table 4.1
Comparison of Base Run for 1986 with Actual 1986 Values.

Crop	Model Solution	%	OMAF (1986)	%
Area (ha):				
Spring Wheat	21,549	0.88	30,636	1.28
Winter Wheat	227,836	9.27	259,576	10.80
Coarse Grains	607,866	24.74	588,880	24.51
Soybeans	397,928	16.19	380,298	15.83
Grain Corn	781,140	31.79	740,259	30.81
Fodder Corn	207,416	8.44	190,091	7.91
O.E.C.	213,465	8.69	213,048	8.86
Total Cropland	2,457,200	100.00	2,402,788	100.00
Production ('000 T):				
Spring Wheat	81.576	0.98	84.4	1.0
Winter Wheat	761.702	9.14	946.5	11.22
Coarse Grains	1,826.332	21.91	1,698.1	20.13
Soybeans	825.195	9.90	932.8	11.05
Grain Corn	4,839.918	58.07	4,776.4	56.60
Total	8,334.723	100.00	8,438.2	100.00

Source: Actual Data from OMAF (1986) and simulation results.

The Export Market Price Scenario

The base scenario is modified to study the consequences of the elimination of the TPWP on the Ontario wheat industry. Prices are set at the 1986 export level. It is assumed that with the removal of the TPWP the HRSW price would fall to the 1986 1CWRS 13.5%, St. Lawrence price level. Prices are: $180.85/tonne for HRSW, $104/tonne for HRWW and $107.50/tonne for CEWW (Table 4.5, column 3).

The results of this scenario are compared with that of the base case to evaluate the impact of eliminating the TPWP on production, exports, and revenue. Ontario production is the sum of the regional production estimates. The changes in production are reflected by the changes in the area planted in each of the regions, since yields are held constant. At the margin the only significant price change is for HRSW, since approximately one-third of CEWW wheat production would be sold at the lower domestic price which in this scenario is equal to export price. It was hypothesized in Figure 2.1 that a decline in the domestic price of HRSW would cause the supply curve for CEWW to shift to the right. However, due to the ratio constraints imposed in the model, a reduction in the area seeded to spring wheat is accompanied by a decline in the winter wheat area, with the result that without the TPWP more area is planted to corn and

soybeans and less to wheat, especially spring wheat (Table 4.2).

Table 4.2
Change in Provincial Area (ha) Planted to each Crop from Base to Export Market Price Scenario.

Crops	With TPWP	Without TPWP	Change in Area Absolute	%
Spring Wheat	21,549	13,660	-7,890	-36.61
Winter Wheat	227,836	206,535	-21,302	-9.35
Coarse Grains	607,866	614,178	6,312	1.04
Soybeans	397,928	399,506	1,578	0.40
Grain Corn	781,140	822,165	41,026	5.25
Fodder Corn	207,416	212,938	5,523	2.66
O.E.C.	213,466	188,219	-25,247	-11.83

Source: simulation results

At the lower export price levels, production of hard red spring wheat decreases due to a 71% decline in the area seeded in Western Ontario. The decline in the Western region brings about a 37% decline in the area of spring wheat seeded in the province (Table 4.2). This indicates that without the program another crop mix is more profitable. Area planted to winter wheat declines by 9% and corn area increases by 8% . With all domestic wheat prices set equal to the lower export prices for wheat, the ratio combination chosen to allocate the available cropland is such that the area planted to corn increases and the planted area for wheat and O.E.C. decreases. Although the ratio constraints are restrictive and may appear to be artificial, they are based

on plantings over a six year period. The utilization of the historical crop mixes seems to be the most practical method used, as explained by McCarl (1982).

Ontario is a net exporter of CEWW wheat. In the model, the domestic milling requirements of CEWW wheat have an upper bound based on domestic demand for this type of wheat; changes in production are reflected in export level. CEWW exports decline by 15% from the base case as a result of the 10% decline in the production of CEWW wheat (resulting in a decline of CEWW export earnings). Production and export changes are presented in Table4.3.

Table 4.3
Change in Provincial Production and Exports from Base Run to Export Market Price Scenario.

Crops	With TPWP	Without TPWP	Absolute Change	% Change
		(tonnes)		
Production				
HRSW	24,007	15,518	-8,489	-35.36
Feed Wheat	95,948	77,193	-18,754	-19.55
CEWW	715,061	643,978	-71,084	-9.94
HRWW	8,262	6,771	-1,491	-18.05
Barley	1,826,332	1,847,085	20,753	1.14
Soybeans	825,195	828,158	2,963	0.36
Grain Corn	4,839,918	5,081,969	242,051	5.00
Exports				
CEWW	491,061	419,978	-71,084	-14.48
Coarse Grains	857,790	1,084,286	226,496	26.40

Source: simulation results.

Exports of coarse grains increase by 26% resulting from an increase in the production of coarse grains and grain corn. In the model, grain corn production is transferred to a barley feed equivalent basis; this is achieved by multiplying grain corn production by the corn/barley energy equivalence factor of .85. Barley is used to represent all coarse grains in demand and trade.

The results indicate that the abolition of the TPWP will have an overall negative effect on the production and export levels of wheat crops due to farmers shifting from wheat to other more profitable crops. The large decline in the HRSW production (35%) might be an indication that the HRSW industry is affected by movements in the policy, implying that the red spring wheat industry may be policy driven.

Clearly, any estimate of the income effect is sensitive to assumptions regarding price, as presented in Table 4.4. The elimination of the policy has an overall negative effect on the production of all wheat crops, especially HRSW. As a result of lower prices, the area planted decreases resulting in lower cash costs for wheat crops. The decline of 12% in cash costs is considerably lower than the 34% decrease in revenue. The difference between revenue and cash costs for all wheat represents the gross margin. The elimination of the program

causes the gross margin for the provincial wheat crop to decline by 58%, but by only 11% when all crops are considered together. The TPWP does have a significant impact on the Ontario wheat industry, which would have experienced considerable financial distress when the program was eliminated if world prices had not recovered from the 1986 levels in response to the North American drought and poor USSR crops.

Table 4.4
Changes in Provincial Revenue from Base to Export Market Price Scenario

Description	With TPWP	Without TPWP	Absolute Change	% Change
	($'000)			
All Crops				
Revenue	1,806,706	1,741,447	-65,259	-3.61
Cash Costs	1,513,477	1,479,414	-34,063	-2.25
Gross Margin	293,229	262,033	-31,196	-10.64
All Wheat				
Revenue	121,833	80,190	-41,643	-34.18
Cash Costs	63,051	55,545	-7,505	-11.90
Gross Margin	58,782	24,645	-34,138	-58.07

Source: simulation results
Note : all crops includes coarse grains, soybeans, OEC, and all wheat crops.

Sensitivity Analysis

The sensitivity of the preceding model solution is analysed for varying levels of domestic wheat prices. The objective is to determine the price level at which shifts in production patterns would occur. The base case was solved with the 1986 domestic prices (presented in Table 4.5, column 2). Prices are then changed to lower levels; it is assumed that with changes in the TPWP domestic prices would fall. These price levels were calculated by subtracting 50% and 75% of the difference between the domestic and export prices from the original domestic prices for wheat.

Table 4.5
Grain Prices Selected for the Policy Experiment Runs. 1986

(1) Crop	(2) Domestic Prices (DP)	(3) Export Prices (EP)	(4) DP-(50% (DP-EP))	(5) DP-(75% (DP-EP))
	($/tonne)			
HRSW	221.39	180.85*	201.12	190.98
SWWW	227.08	107.50	167.29	137.39
HRWW	221.39	104.00	162.60	133.35

Source: OWPMB
Notes: *with the removal of the TPWP it is assumed that the price for HRSW is equal to the 1986 1CWRS 13.5%, St. Lawrence, since Ontario is a net importer of HRSW.

Reducing the benefit of the TPWP by 50%(DP-EP) does not affect production; however, lower wheat prices do decrease the gross margin for wheat by some 25% (Table 4.6). A decline in the benefit of the TPWP of 75%(DP-EP) does change the base case solution (Table 4.6). Under these lower prices the acreage results are the same as those under the complete elimination of the TPWP (Table 4.2). Gross margin for wheat production declines by 45%.

This seems to indicate, that producers would be relatively insensitive to small reductions in domestic prices as far as the crop selection is concerned.

Table 4.6
Price Sensitivity Analysis

Description	Units	Base Solution	Price Sensitivity	Absolute Change	% Change
With DP-50%(DP-EP):					
All Crops:					
Revenue	($'000)	1,806,706	1,791,813	-14,893	-0.82
Cash Costs	($'000)	1,513,477	1,513,477	0	0.00
Gross Margin	($'000)	293,229	278,336	-14,893	-5.08
All Wheat:					
Revenue	($'000)	121,833	106,940	-14,893	-12.22
Cash Costs	($'000)	63,051	63,051	0	0.00
Gross Margin	($'000)	58,782	43,889	-14,893	-25.34
With DP-75%(DP-EP):					
All Crops:					
Revenue	($'000)	1,806,706	1,749,287	-57,419	-3.18
Cash Costs	($'000)	1,513,477	1,479,414	-34,063	-2.25
Gross Margin	($'000)	293,229	269,873	-23,356	-7.97
All Wheat:					
Revenue	($'000)	121,833	88,030	-33,803	-27.75
Cash Costs	($'000)	63,051	55,545	-7,505	-11.90
Gross Margin	($'000)	58,782	32,485	-26,297	-44.74
Area:					
Spring Wheat	(HA)	21,549	13,660	-7,890	-36.61
Winter Wheat	(HA)	227,836	206,535	-21,302	-9.35
Barley	(HA)	607,866	614,178	6,312	1.04
Soybeans	(HA)	397,928	399,506	1,578	0.40
Grain Corn	(HA)	781,140	822,165	41,026	5.25
Fodder Corn	(HA)	207,416	212,938	5,523	2.66
O.E.C.	(HA)	213,466	188,219	-25,247	-11.83

Source: simulation results.

Relaxing the Cropping Ratio Constraint

In the analysis so far, spring wheat area is restricted to a set of cropping options which reflects historic combinations of crops. The cropping ratios are based on observations in each region in Ontario over the six year period, 1981 to 1986. However, new technology usually means that past practices may be altered and historic constraints may not reflect future potential production trends very well. To evaluate the potential impact of the new technology -in this case the adoption of new varieties of hard red spring wheat in Ontario- the ratio constraints are relaxed allowing greater flexibility for the model to select an optimum seeding plan.

The cropping ratio constraint is relaxed in two stages. The first stage is to combine all land historically planted to wheat. This means that spring and winter wheats are allowed to compete for the same land. The assumption here is that these two types of wheat are very close substitutes in production. The second stage is to extend the substitution possibilities to land historically planted to barley (coarse grains). This assumes that all small grains are considered close substitutes in production. These two substitution scenarios are first analysed with the TPWP in place to evaluate the potential for increasing the acreage of hard red spring wheat in Ontario when distorted

price signals exist.

(i) Substitution Between Spring and Winter Wheat

The results of spring and winter wheat competing directly with each other for cropland are presented in Table 4.7. The results are compared with the base case solution in which spring and winter wheat are restricted to historic planting levels by the crop ratio constraints. The results of the analysis in this scenario could be underestimating the area planted to winter wheat, since winter wheat is sometimes grown for reason such as to reduce soil erosion or to provide an earlier harvest period to the farmer. These factors which often provide economic benefits are not analyzed in this study. However, the use of historic cropping patterns should minimize such omission.

In this scenario when substitution is allowed between spring and winter wheats, the percentage of total cropland seeded to spring wheat expands from the restricted base level of 0.9% to 8%, and area seeded to winter wheat declines from 9% to 4%. In three out five regions (South, Center and East), there is a complete shift to spring wheat, while the western and northern regions specialize in the production of winter wheat. Although it is not realistic to anticipate that regions would specialize completely in one type of wheat, the results do show that with

the distorted prices caused by the TPWP, there exists an incentive to expand production of HRSW by reducing production of CEWW and that this incentive is greater in some regions than in others.

It is important to note that although regional specialization did ensue, provincial specialization did not occur. Some winter wheat continues to be exported and some CWRS continues to be shipped from western Canada at greatly reduced levels, resulting in a shift in Canada's trade pattern in terms of less winter wheat being exported to the world and less spring wheat imported from Thunder Bay into Ontario.

Table 4.7
Provincial Area Planted to each Crop under the TPWP With and Without the Ratio Constraints

Crop	Base Solution	Substit. Solution	Change in Area Planted	
	(Hectares)			(%)
Spring Wheat	21,549	196,586	175,037	812.27
Winter Wheat	227,836	90,450	-137,387	-60.30
Barley	607,866	611,353	3,487	0.57
Soybeans	397,928	393,307	-4,621	-1.16
Grain Corn	781,140	745,325	-35,815	-4.58
Fodder Corn	207,416	207,325	-91	-0.04
Area-O.E.C.	213,466	212,855	-611	-0.29

Scenarios: with the two price wheat program.
Base solution: winter and spring wheat compete indirectly.
Substit. solution: winter and spring wheat compete directly

(ii) Substitution Between Spring, Winter Wheat and Barley

When substitution possibilities are extended to barley[1], the model solution indicates that wheat takes over the area seeded to barley to a very great extent. The reduced production of barley is replaced by imports of barley from the West. This again indicates that distorted domestic prices could result in significant adjustments to production patterns, even to the extent that farmers might replace grain grown largely for on farm feeding with purchased grain, electing to grow wheat to take advantage of high domestic prices for HRSW. However, the current model does not fully capture all factors that farmers take into consideration in deciding to produce their own feed grain. This is felt to be a serious limitation and further research is required into the substitutability of barley and wheat.

Impact of the Abolition of the TPWP and Relaxing Cropping Ratio Constraint

In this scenario spring and winter wheat are allowed to compete for cropland historically planted to wheat, as in the previous scenario. This is modified by eliminating the TPWP, reducing domestic prices to those employed in the export market price scenario. The specific question being addressed here is

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[1]including rye, oats and mixed grains.

whether the incentive to alter historic cropping patterns will be as great under world prices as under the TPWP.

With the TPWP in place the results show that when substitution is allowed between spring and winter wheat, the extent to which technology is adopted by farmers in the production of HRSW is quite large (Table 4.8, columns 2 and 3). This large increase in the HRSW acreage represents a misallocation of regional resources under price distortions, since producers might be using more input resources to grow the red wheat which is consumed locally at higher domestic prices versus white winter wheat which is exported on a competitive basis from Ontario at lower prices. This indicates that distortions to resources use under the TPWP could be large enough to originate a policy driven red spring wheat industry in Ontario.

With the removal of the program there is still an increase in spring wheat seeded acreage, but very much smaller (Table 4.8, column 5). In this scenario the Central region could have produced either wheat, but based on the relative prices and costs of production introduced in the model, and the amount of wheat that goes into the feed and food market, there seems to be some advantage in this region to produce HRSW over CEWW wheat at world prices. In terms of the magnitude, the advantage in the Central

region to grow HRSW results in a total acreage which is close to the 1986 acreage seeded. The fact that with the removal of the program, producers still increase the production of spring wheat, but only very slightly, suggests that improvements of the spring wheat varieties will probably continue without the program but to a lesser extent. This implies that with no price distortions red spring wheat technology will continue to be adopted based on the comparative advantage of growing this crop in Ontario.

With respect to winter wheat at the lower domestic prices the percentage of total cropland seeded to winter wheat relative to base declines by a small amount (3.7%), indicating that the white winter wheat industry, which is based on comparative advantage, is not as susceptible to policy movements as in the case of HRSW.

Table 4.8
Provincial Area Planted to each Crop With and Without the TPWP and With and Without the Substitution Between Spring and Winter Wheat

	With TPWP		Without TPWP	
(1) Crops	(2) Base Solution	(3) Substit. Allowed	(4) Base Solution	(5) Substit. Allowed
Spring Wheat	21,549	196,586	13,660	30,575
Winter Wheat	227,836	90,450	206,535	219,490
Coarse Grains	607,866	611,353	614,178	606,732
Soybeans	397,928	393,307	399,506	397,928
Grain Corn	781,140	745,325	822,165	781,140
Fodder Corn	207,416	207,325	212,938	207,325
O.E.C.	213,466	212,855	188,219	214,010

Source: simulation results.

Modifiying Assumptions and Limitations

The results must be interpreted in the context of the model used to derive them. All models constitute an abstraction of reality, and in making simplifying assumptions, details are often suppressed which could affect these estimates. Four concerns are identified below.

First, the selection of cropping patterns are highly simplified in this study. Essentially, they are modeled by sets of cropping options which reflect combinations of crop ratios

based on historical observations in each region over a six year period. This method could be inappropriate in any analysis dealing with the introduction of new technology which would cause producers to deviate from past patterns.

To overcome this problem, the ratio constraint was relaxed to allow more direct competition between HRSW, CEWW and barley. When this experiment was conducted, the sensitivity of the model to the ratios or cropping mixes illustrate that how the model is constrained is critical. A preferable method would be to allow the model to freely determine the optimal rotation without these relatively inflexible constraints. At this juncture, the requirements of a more flexible model seem suitable for future research.

Second, the results of the model represent average values based on 1986 prices and costs, and mean yields over a six year period. Although 1986 is used, it may not have represented an equilibrium situation, and in fact world prices were highly distorted in 1986 due to an escalation in the US-EC agricultural trade conflict. However, all world grain prices were similarly depressed and since it is relative prices that affect the solution, the conclusions drawn would still hold.

Yields, and prices do fluctuate over time and consequently

risk considerations are important. Production activities could be modified to incorporate risk, as risk factors are believed to be an important influence in farmers' decisions. A farmer associates a degree of risk with each crop based on historical observations, possibly adjusted subjectively. Another point related with risk in the model is that in the production of HRSW wheat it is assumed that only forty percent of the wheat will grade milling quality. This implies that production of HRSW wheat involves greater risk with 60% of total output ending up as feed wheat. However, the degree of risk associated with HRSW wheat ending as feed wheat is based on only one observation for 1986, and this risk may diminish with time as improved varieties are developed and licensed, and better management practices evolve.

Third, the study does not focus on the economy-wide benefits of the removal of the TPWP program. The study focuses on the impact this policy has on the production of wheat in Ontario, largely ignoring the effects on other sectors, as well as the multiplier effects of increased earnings. Assuming the domestic price of wheat decreases to the export level, producers of wheat in Eastern Canada would suffer a loss in revenue. The Canadian milling industry would be favored by the lower wheat prices. Consequently, the economy-wide benefits could exceed the sector-based results examined in this study.

Finally, the usual relative prices for CEWW wheat and feed wheat over the 1981 to 1986 period show that the export price of CEWW wheat seems to be similar to the wheat prices for feed purposes, or some what higher, up to 1984 but in 1985 and 1986 domestic feed wheat prices move above export prices; this constitutes a distorted relationship between the prices of food quality wheat and feed quality wheat. This distorted price relationship did not seem to bias the overall results to grow spring wheat, because in the model it is assumed that 60% of the HRSW crop is going into feed wheat. It is also assumed that if the higher feed prices would have biased the model results, HRSW would have been grown in most of the regions; this did not occur implying that the price distortion was not enough to affect the model results.

Conclusions

The 1986 changes in the TPWP, which were intended to protect producers against depressed world prices, encouraged the development and adoption of new red spring wheat varieties in Ontario. Output of the HRSW was stimulated by domestic prices higher than the world price, as well as domestic prices for other crops. This increase in output enlarged Ontario wheat producers' share of the domestic market. Imports of CWRS from Thunder Bay declined because the more wheat grown in the East, the less is needed from the West, and the less Western producers benefited from the TPWP.

To study the extent to which HRSW technology would be adopted relative to other cropping alternatives, several scenarios of the model were developed. The results show that with the TPWP in place: there is an incentive to produce HRSW in three Ontario regions, South, Center and East, at the expense of the production of CEWW wheat. Secondly, Ontario trade patterns are affected since less winter wheat would be exported and less red wheat imported from Western Canada.

With the TPWP removed: the model results indicate that the new HRSW varieties would be adopted anyway but to a lesser extent

than with the program in place. It also appears that the Central region in Ontario would have some comparative advantage in growing red spring wheat over winter wheat at world prices. This indicates that it is more advantageous to grow HRSW in the central instead of the western region; overall acreage, however, would not increase from the 1986 acreage seeded to HRSW. Based on current knowledge of relative profitability, yields, quality and cost, the HRSW crop would not expand beyond what is now planted in Ontario. If the parameters change or if management improves and new higher yielding varieties of red spring are found, then these factors could modify this conclusion.

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APPENDIX A

The Pooling Price in the CEWW Market

Appendix A: The Pooling Price in the CEWW Market.

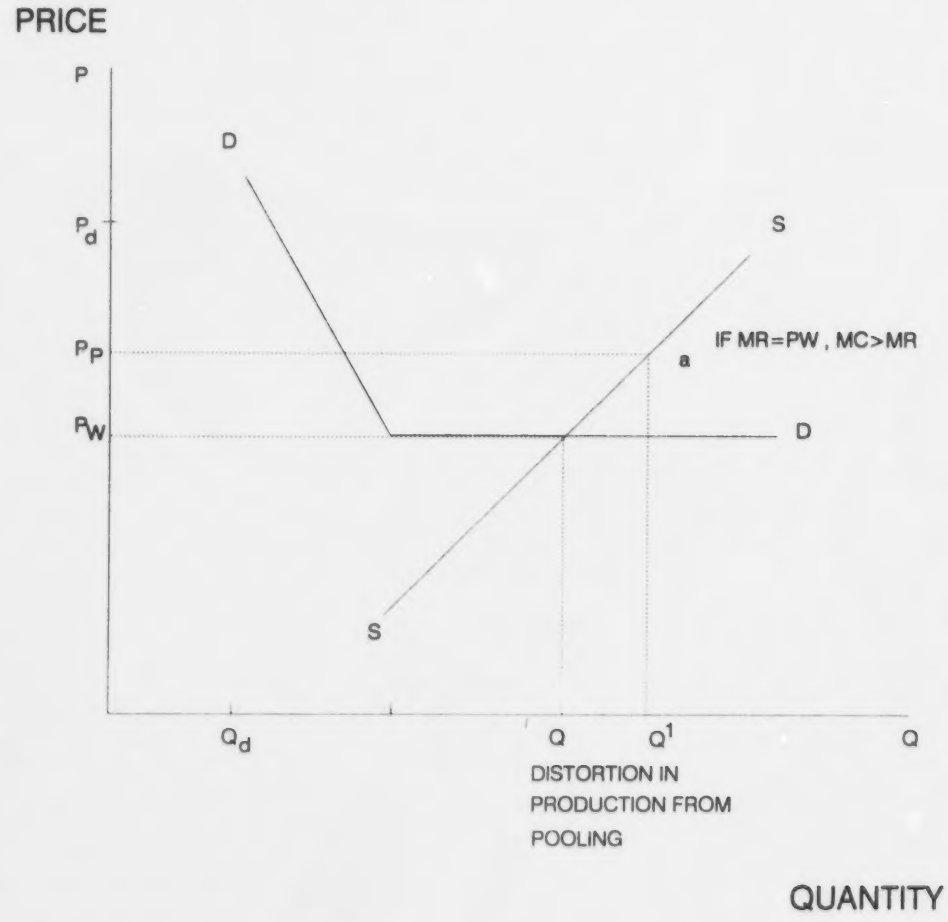
In the CEWW wheat market, (Figure A.1), with the domestic price set at Pd and the world price at Pw, the producers' price (Pp) is the weighted average of these two prices and of quantities consumed in domestic and international markets. Pp will fall between the Pd and the Pw prices, but as a result of the proportions consumed in both markets (1/3 vs. 2/3) the pooling price falls closer to the export price. In 1986 the pool price was $110/T based on a domestic return of $227/T and export price of $108/T (Table 1.2).

In response to price Pp producers would increase supply to Q' from Q. The combined effect of the TPWP and price pooling is to increase production and exports. At Q' marginal revenue, Pw, would be less than marginal cost. Therefore, price pooling can result in distortions such that CEWW production might be higher (Q' instead of Q) if producers expectations are based on the pooled price, instead of on the export price where most production is sold.

Any changes in the domestic price will affect the pooling price, and any changes in the pooling price will affect the

quantity of CEWW wheat produced. In Figure A.1, with the TPWP removed, the pooled price falls from Pp to Pw resulting in a movement along the supply curve S, reducing production from Q' to Q. Price pooling is not incorporated into the current version of the model and therefore the results reported do not include the pooling effect in the impact of removing the TPWP on the Ontario wheat industry.

FIGURE A.1 IMPACT OF PRICE POOLING ON THE CEWW MARKET



APPENDIX B

Structure of the Model in Tableau Form

Appendix B: Structure of the Model in Tableau Form.

The submatrices of the model may be grouped into the following three sets of activities: production, trade and domestic demand. Concerning the rows of the model, four major types may be identified. There are resource constraint rows, commodity balance rows, accounting rows and ratio rows. Resource constraint rows deal mainly with land availability. Commodity balance rows deal with supply utilization for each of the major commodity items following the general specification that use cannot exceed supply. Accounting rows are used primarily to keep track of cash costs, and ratio rows have been specified to allow for alternative crop rotations.

The symbols used in the tableaus are defined as follows:

A_{ij} : submatrix in the i^{th} row and j^{th} column position of a larger matrix,

B_j : set of structural bounds associated with the j^{th} column,

C_{ij} : column or row vector in the i^{th} row, j^{th} column position of a larger matrix, dealing with costs or prices,

C_j : row vector of objective function coefficients in the

j^{th} column position,

R_i : set of right hand side values associated with the i^{th} row,

superscript "+" : all values of matrix or vector are non-negative,

superscript "-" : all values of matrix or vector are non-positive,

a : positive coefficient,

$\bar{a}$: negative coefficient,

Figure B.1 portrays the linear programming tableau for the general structure of the Ontario crop block. The objective function row accounts for all revenues and cash costs associated with the model's activities. The submatrix C1 represents the direct subsidies received by the producer from programs such as the WGSA, SCGP and ASA. The submatrix C2 accounts for the Thunder Bay shipments, which is modeled as an import cost to the Ontario producers, since Ontario may have to import grain to meet domestic requirements. Crop exporting activities, interprovincial and international, are represented by the submatrices C3, C4, and C5. The submatrix C6 represents the domestic demand at the provincial level. Hence, except for C2 these groups of activities account for income earned from agriculture while C7 is an accounting column or vector that subtracts all production costs (C1,1) and all transport costs

FIGURE B.1 TABLEAU ON THE GENERAL STRUCTURE OF THE ONTARIO CROP BLOCK

		TRADE						
	Crop Production	Thunder Bay	Quebec	Maritimes	International	Domestic Demand	Net Cost	RHS
Objective function	C_1^+	C_2^-	C_3^+	C_4^+	C_5^+	C_6^+	C_7^-	
Cash Cost	C_{11}^+		C_{13}^+	C_{14}^+	C_{15}^+		C_8	≤ 0
Crop Production	A_{21}		A_{23}	A_{24}	A_{25}	A_{26}		≤ 0
National Production	A_{31}					A_{36}		≤ 0
Forage and Pasture Production	A_{41}					A_{46}		≤ 0
Bounds			B_3	B_4		B_6		

(C1,3, C1,4, and C1,5). These transport costs are defined for each of the shipping activities in the model which include shipments of the different wheats from Ontario to Quebec and the Maritimes and transportation costs to the export ports. All these costs are summed (C8) and subtracted (C7) from the total revenue.

The structure is best understood by examining the links between each submatrix in column order and row order. For example, crop production activities illustrated by submatrix A2,1 are linked by column to A3,1, and by row to A23, A24, A25, and A26. The link between A2,1 and A3,1 is through production or yields. Cropping activities generate production which is detailed at the regional or provincial level, while other activities generate production which is accounted for at the national level. At the provincial level supply (A2,1) is shipped to other provinces (A2,3 and A2,4) or to export (A2,5), or is retained for meeting provincial demand (A2,6). The different varieties of wheat production, for example, are modeled at the regional level (where production is a row in submatrix A2,1) with use represented by A2,3, A2,4, A2,5, A2,6. Thus, wheat is exported (A2,5) or shipped to other provinces (A2,3 and A2,4), or consumed domestically (A2,6). At the national level, A3,1 account for the supply of certain crops that fall into the national pool, and the domestic demand or sales of these are specified through

submatrix A3,6. As with all accounting identities, use must be less than or equal to supply.

Bounds or Right Hand Sides (RHS) specify constraints and are also used to specify activity levels for exogenously specified variables. In this particular study, the amount consumed in Ontario as well as upper limit on the amount transferred to Quebec and the Maritimes is determined exogenously and is specified with the corresponding bounds. Land availability is specified with a RHS constraint at the regional level.

Figure B.2, presents the structure of the crop production sector of the model. There is one crop production block for each region. In Figure B.1 the crop production block for Ontario province is represented by the submatrices in the first column of the tableau. These submatrices are expanded upon in Figure B.2 showing more structural details.

The submatrix A2,1 in Figure B.1 is the accumulation of regional production which will be used at the domestic and export levels. Generally, those crops that can be exported are specified at the regional level, those which can be used only for feed (forage including corn silage and pasture) are specified at the regional level and are used for feed at the provincial level (See in Figure B.1 A4,1 and A4,6)

FIGURE B.2 TABLEAU ON THE STRUCTURE OF THE REGIONAL CROP PRODUCTION BLOCK

		Uses of Land: Cropland W.W.	S.W.	C.G.	S	G.C.	S.C.	OEC	Other Land T.H.	T.P.	U.L.	Set of Crop Ratios 1	2	3	4	5	6	7	Right Hand Side	
Production Costs		a	a	a	a	a	a	a	a	a	a								≤ 0	C_{11} (Fig. B.1)
Land Constraints	Cropland	1	1	1	1	1	1	1											≤	Land in Crops
	Tame Hay (T.H.)								1										≤	Land in Hay
	Tame Pasture (T.P)									1									≤	Land in Pasture
	Unimprov. Land (U.L.)										1								≤	Unimprov. Land
Crop Ratios	Winter Wheat (W.W.)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	Spring Wheat (S.W.)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	Coarse Grains (C.G.)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	Soy (S)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	Grain Corn (G.C.)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	Silage Corn (S.C.)											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
	OEC											$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	$\bar{a}$	≤	0
Crop Yields	Winter Wheat (W.W.)	$\bar{a}$																	≤	0
	Spring Wheat (S.W.)		$\bar{a}$																≤	0
	Coarse Grains (C.G.)			$\bar{a}$															≤	0
	Soy (S)				$\bar{a}$														≤	0
	Grain Corn (G.C.)					$\bar{a}$													≤	0
	OEC							$\bar{a}$											≤	0
Crop Balance	Stored Forage (including corn silage)						$\bar{a}$		$\bar{a}$										≤	0
	Pasture									$\bar{a}$	$\bar{a}$								≤	0

A_{21} (Fig. B.1)

A_{41} (Fig. B.1)

The submatrices C1,1, A2,1, and A4,1 for each crop region are expanded upon in Figure B.2.

The rows consist of:

1. Input requirements including cash costs and land constraints.
2. Ratios constraining the quantity of each crop planted.
3. Regional crop yield

The columns consist of:

1. Uses of crop land.
2. Set of ratios controlling the mix of crops planted.

APPENDIX C

Regional Data

TABLE C1.1: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMERCIAL FRUIT

(1981)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	11,370	8,373	5,727	401		25,871
CHERRIES, SWEET	1,060		10			1,070
CHERRIES, TART	2,279	95	126			2,500
GRAPES	22,766	53				22,819
PEACHES	7,905	65				7,970
PEARS	3,243	135	127			3,505
PLUMPS & PRUNES	1,468	14	15			1,497
RASPBERRIES	131	150	218	72	11	582
STRAWBERRIES	1,445	588	616	431	50	3,130
BLUEBERRIES						0
CANTALOUPES	113					113
	51,780	9,473	6,839	904	61	69,057

(1982)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	11,993	8,037	6,349	446		26,825
CHERRIES, SWEET	1,043		9			1,052
CHERRIES, TART	2,134	38	35			2,207
GRAPES	23,351	50				23,401
PEACHES	6,810	65				6,875
PEARS	3,250	113	120			3,483
PLUMPS & PRUNES	1,419	10	15			1,444
RASPBERRIES	130	161	226	116		633
STRAWBERRIES	1,488	554	652	528	61	3,283
BLUEBERRIES						0
CANTALOUPES	106					106
	51,724	9,028	7,406	1,090	61	69,309

(1983)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	11,251	7,688	6,124	557		25,620
CHERRIES, SWEET	1,034	1				1,035
CHERRIES, TART	2,123	28	10			2,161
GRAPES	23,281	18	0			23,299
PEACHES	6,667	110				6,777
PEARS	3,191	51	73			3,315
PLUMPS & PRUNES	1,392	10				1,402
RASPBERRIES	123	165	203	100	15	606
STRAWBERRIES	1,447	538	677	498	73	3,233
BLUEBERRIES						0
CANTALOUPES	113					113
	50,622	8,609	7,087	1,155	88	67,561

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C1.2: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMERCIAL FRUIT

(1984)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	11,301	7,689	6,079	534		25,603
CHERRIES, SWEET	1,044	0	0			1,044
CHERRIES, TART	2,123	28	102			2,253
GRAPES	23,281	18	9			23,308
PEACHES	6,667	110				6,777
PEARS	3,123	51	75			3,249
PLUMPS & PRUNES	1,392	10	9			1,411
RASPBERRIES	123	167	208	125	19	642
STRAWBERRIES	1,404	523	789	641	75	3,432
BLUEBERRIES						0
CANTALOUPES	207					207
	50,665	8,596	7,271	1,300	94	67,926

(1985)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	12,019	7,790	5,527	571		25,907
CHERRIES, SWEET	1,036	9	2	0		1,047
CHERRIES, TART	2,105	31	30			2,166
GRAPES	23,376	20	2			23,398
PEACHES	7,410	73	0			7,483
PEARS	2,998	139	185			3,322
PLUMPS & PRUNES	1,740	63	21			1,824
RASPBERRIES	257	193	212	143	42	847
STRAWBERRIES	1,641	940	674	761	99	4,115
BLUEBERRIES	296					296
CANTALOUPES	228					228
	53,106	9,258	6,653	1,475	141	70,633

(1986)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
APPLES	12,723	7,895	5,057	523		26,198
CHERRIES, SWEET	984	40	2	4		1,030
CHERRIES, TART	1,955	80	95			2,130
GRAPES	23,035	20	9			23,064
PEACHES	7,139	58	3			7,200
PEARS	3,132	189	179			3,500
PLUMPS & PRUNES	1,533	72	45			1,650
RASPBERRIES	230	246	335	234	22	1,067
STRAWBERRIES	1,667	1,040	803	732	136	4,378
BLUEBERRIES	472					472
CANTALOUPES	282					282
	53,152	9,640	6,528	1,493	158	70,971

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.1: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1981)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	1,933	670	57	7		2,667
BEANS, GREEN & WAX (FRESH)	1,491	150	219	60	9	1,929
BEETS BUNCHING	8	5	44	30	7	94
BEETS, TOPPED	594	70	43	10	2	719
BROCCOLI	110	32	136	35		313
BRUSSELS SPROUTS	129		1			130
CABBAGE	2,393	574	750	135	41	3,893
CARROTS, TOPPED	785	2,669	1,055	100	7	4,616
CARROTS BUNCHING	37		9	30	3	79
CAULIFLOWER	1,378	601	795	66	8	2,848
CORN, SWEET	2,183	911	1,416	1,050	134	5,694
CELERY	169	293	239			701
CUCUMBER, FIELD (FRESH)	381	69	54	55	15	574
LETTUCE, HEAD (FRESH)	224	603	382	40	2	1,251
ONNIONS, BUNCHING	139	24	147	40	3	353
ONNIONS, DRY SETS	743		2		1	746
ONIONNS, DRY SILVERSKIN	82					82
ONIONNS,DRY SPANISH	210		55			265
ONIONNS, DRY YELLOWSEED	1,108	2,028	1,101			4,237
PARSNIPS	72	75	151		2	300
PEPPERS	1,514	75	161	40		1,790
POTATOES	10,532	19,762	3,515	1,280	1,207	36,296
RUTABAGAS	900	2,443	254	93	47	3,737
SPINACH	485		100			585
TOMATOES, FIELD (FRESH)	1,561	424	740	172	5	2,902
BEANS: GREEN, WAX: PROC	1,950	900	150			3,000
BEANS: LIMA, PROC	468	216	36			720
CORN: SWEET, PROC	14,800	11,100	11,100			37,000
CUCUMBER: FIELD, PROC	1,880	1,410	1,410			4,700
PEAS: GREEN, PROC	7,600	5,700	5,700			19,000
PUMKIN & SQUASH: PROC	300	225	225			750
RADISHES	284	72	154	28	7	545
TOMATOES: PROC	16,200		10,800			27,000
	72,643	51,101	41,001	3,271	1,500	169,516

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.2: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1982)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	1,671	421	85	7		2,184
BEANS, GREEN & WAX (FRESH)	1,747	125	220	60	6	2,158
BEETS BUNCHING	7	5	46	28	5	91
BEETS, TOPPED	460	50	34	10	2	556
BROCCOLI	108	32	136	35		311
BRUSSELS SPROUTS	116	2	2	2		122
CABBAGE	2,410	548	1,016	112	35	4,121
CARROTS, TOPPED	819	2,229	1,859	25	14	4,946
CARROTS BUNCHING	34		8	30	3	75
CAULIFLOWER	1,581	699	1,115	87	7	3,489
CORN, SWEET	2,297	1,069	1,305	1,620	132	6,423
CELERY	159	268	158			585
CUCUMBER, FIELD (FRESH)	430	90	89	54	10	673
LETTUCE, HEAD (FRESH)	240	605	373	38		1,256
ONNIONS, BUNCHING	136	24	146	42	3	351
ONNIONS, DRY SETS	747		2		2	751
ONIONNS, DRY SILVERSKIN	64					64
ONIONNS,DRY SPANISH	423		58			481
ONIONNS, DRY YELLOWSEED	1,137	1,767	1,401			4,305
PARSNIPS	77	115	227	3	2	424
PEPPERS	1,908	76	166	39		2,189
POTATOES	11,169	21,879	2,760	1,051	1,439	38,298
RUTABAGAS	852	2,387	192	81	58	3,570
SPINACH	565	100				665
TOMATOES, FIELD (FRESH)	1,694	547	790	158	12	3,201
BEANS: GREEN, WAX: PROC	2,464	1,137	190			3,790
BEANS: LIMA, PROC	650	300	50			1,000
CORN: SWEET, PROC	16,280	12,210	12,210			40,700
CUCUMBER: FIELD, PROC	1,760	1,320	1,320			4,400
PEAS: GREEN, PROC	8,960	6,720	6,720			22,400
PUMKIN & SQUASH: PROC	440	330	330			1,100
RADISHES	188	72	154	28	7	449
TOMATOES: PROC	16,440		10,960			27,400
	78,033	55,127	44,122	3,510	1,737	182,528

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.3: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1983)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	2,126	669	120	31		2,946
BEANS, GREEN & WAX (FRESH)	1,860	253	263	53		2,429
BEETS BUNCHING	7	5	45	28		85
BEETS, TOPPED	294	50	19	8		371
BROCCOLI	232	124	133	38		527
BRUSSELS SPROUTS	173	1	2	2		178
CABBAGE	2,486	663	1,019	90	35	4,293
CARROTS, TOPPED	701	2,200	1,717	18		4,636
CARROTS BUNCHING	16	18	30			64
CAULIFLOWER	1,703	774	1,203	61		3,741
CORN, SWEET	2,527	937	2,216	1,402	140	7,222
CELERY	176	293	207			676
CUCUMBER, FIELD (FRESH)	465	92	51	44		652
LETTUCE, HEAD (FRESH)	275	522	400	36		1,233
ONNIONS, BUNCHING	110	26	143	41		320
ONNIONS, DRY SETS	731					731
ONIONNS, DRY SILVERSKIN	82					82
ONIONNS,DRY SPANISH	314	56				370
ONIONNS, DRY YELLOWSEED	1,211	1,825	1,462			4,498
PARSNIPS	57	91	100			248
PEPPERS	1,977	60	315	31		2,383
POTATOES	10,883	21,326	2,826	1,086	1,418	37,539
RUTABAGAS	1,000	2,660	15	100	60	3,835
SPINACH	650	100				750
TOMATOES, FIELD (FRESH)	1,725	557	1,935	109		4,326
BEANS: GREEN, WAX: PROC	1,690	780	130			2,600
BEANS: LIMA, PROC	423	195	33			650
CORN: SWEET, PROC	13,800	10,350	10,350			34,500
CUCUMBER: FIELD, PROC	1,480	1,110	1,110			3,700
PEAS: GREEN, PROC	6,400	4,800	4,800			16,000
PUMKIN & SQUASH: PROC	520	390	390			1,300
RADISHES	213	37	152	28		430
TOMATOES: PROC	16,800		11,200			28,000
	73,107	50,964	42,386	3,206	1,653	171,315

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.4: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1984)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	2,262	799	144	35	11	3,251
BEANS, GREEN & WAX (FRESH)	1,774	260	269	53	3	2,359
BEETS BUNCHING	5	5	47	24	2	83
BEETS, TOPPED	309	95	4	8	2	418
BROCCOLI	630	166	140	36		972
BRUSSELS SPROUTS	167	1	2	0		170
CABBAGE	2,698	675	1,495	78	30	4,976
CARROTS, TOPPED	615	2,365	1,842	18	2	4,842
CARROTS BUNCHING	19		20	24	2	65
CAULIFLOWER	1,427	828	1,264	72	2	3,593
CORN, SWEET	2,634	1,126	2,561	1,743	78	8,142
CELERY	138	284	197			619
CUCUMBER, FIELD (FRESH)	440	94	76	44	7	661
LETTUCE, HEAD (FRESH)	264	499	375	40		1,178
ONNIONS, BUNCHING	136	26	143	36	2	343
ONNIONS, DRY SETS	673					673
ONIONNS, DRY SILVERSKIN	70					70
ONIONNS,DRY SPANISH	165	30				195
ONIONNS, DRY YELLOWSEED	1,239	1,875	1,508			4,622
PARSNIPS	52	107	121		1	281
PEPPERS	1,359	175	190	34		1,758
POTATOES	12,314	21,578	2,974	1,171	1,369	39,406
RUTABAGAS	900	2,742	17	66	40	3,765
SPINACH	548	250				798
TOMATOES, FIELD (FRESH)	1,676	508	2,330	112		4,626
BEANS: GREEN, WAX: PROC	2,470	1,140	190			3,800
BEANS: LIMA, PROC	471	218	36			725
CORN: SWEET, PROC	14,800	11,100	11,100			37,000
CUCUMBER: FIELD, PROC	1,680	1,260	1,260			4,200
PEAS: GREEN, PROC	7,600	5,700	5,700			19,000
PUMKIN & SQUASH: PROC	580	435	435			1,450
RADISHES	208	12	152	26	3	401
TOMATOES: PROC	18,300		12,200			30,500
	78,623	54,353	46,792	3,620	1,554	184,942

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.5: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1985)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	2,657	928	223			3,808
BEANS, GREEN & WAX (FRESH)	1,807	255	260	86	45	2,453
BEETS BUNCHING	95	15	36	8	43	197
BEETS, TOPPED	310	67	48	2	0	427
BROCCOLI	1,249	258	200	50		1,757
BRUSSELS SPROUTS	74	5	60	8		147
CABBAGE	2,656	579	1,322	48	21	4,626
CARROTS, TOPPED	907	1,547	2,581	20	5	5,060
CARROTS BUNCHING	23	88	96	19	42	268
CAULIFLOWER	1,816	991	848	71	7	3,733
CORN, SWEET	5,697	1,643	2,987	1,017	143	11,487
CELERY	161	254	233			648
CUCUMBER, FIELD (FRESH)	626	63	44	54	34	821
LETTUCE, HEAD (FRESH)	232	486	469	11		1,198
ONNIONS, BUNCHING	155	59	128	12	42	396
ONNIONS, DRY SETS	706		121			827
ONIONNS, DRY SILVERSKIN	98					98
ONIONNS,DRY SPANISH	411		31			442
ONIONNS, DRY YELLOWSEED	1,228	1,293	1,977			4,498
PARSNIPS	60	127	52		20	259
PEPPERS	2,912	293	139	38		3,382
POTATOES	11,258	20,884	2,864	1,171	1,352	37,529
RUTABAGAS	954	2,111	50	75	43	3,233
SPINACH	223	216	106			545
TOMATOES, FIELD (FRESH)	2,285	143	2,264	113		4,805
BEANS: GREEN, WAX: PROC	2,454	1,133	189			3,776
BEANS: LIMA, PROC	488	225	38			751
CORN: SWEET, PROC	14,247	10,685	10,685			35,618
CUCUMBER: FIELD, PROC	1,580	1,185	1,185			3,950
PEAS: GREEN, PROC	7,143	5,357	5,357			17,858
PUMKIN & SQUASH: PROC	434	326	326			1,086
RADISHES			475			475
TOMATOES: PROC	16,066		10,710			26,776
	81,013	51,217	46,104	2,803	1,797	182,934

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C2.6: ONTARIO REGIONAL AND PROVINCIAL AREA IN ACRES OF COMMERCIAL VEGETABLE CROPS

(1986)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
ASPARAGUS	2,983	1,067	259			4,309
BEANS, GREEN & WAX (FRESH)	2,019	285	291	96	50	2,741
BEETS BUNCHING	90	16	42	15		163
BEETS, TOPPED	295	69	55	4	13	436
BROCCOLI	1,537	567	329	156		2,589
BRUSSELS SPROUTS	79	96	14	7		196
CABBAGE	2,074	767	721	73	43	3,678
CARROTS, TOPPED	1,154	1,470	2,982	28	2	5,636
CARROTS BUNCHING	30	84	110	26	16	266
CAULIFLOWER	2,030	909	1,012	94	16	4,061
CORN, SWEET	6,037	2,484	3,610	1,539	217	13,887
CELERY	188	261	201			650
CUCUMBER, FIELD (FRESH)	684	69	48	58	37	896
LETTUCE, HEAD (FRESH)	474	556	563	28		1,621
ONNIONS, BUNCHING	158	120	131	12	43	464
ONNIONS, DRY SETS	676		116			792
ONIONNS, DRY SILVERSKIN	94					94
ONIONNS,DRY SPANISH	394		30			424
ONIONNS, DRY YELLOWSEED	1,177	1,239	1,894			4,310
PARSNIPS	40	136	61		4	241
PEPPERS	3,381	206	133	35		3,755
POTATOES	8,898	17,994	2,794	1,167	1,273	32,126
RUTABAGAS	828	2,359	66	82	58	3,393
SPINACH	232	197	69			498
TOMATOES, FIELD (FRESH)	2,597	163	2,574	128		5,462
BEANS: GREEN, WAX: PROC	2,675	1,235	206			4,116
BEANS: LIMA, PROC	675	311	52			1,038
CORN: SWEET, PROC	12,861	9,646	9,646			32,153
CUCUMBER: FIELD, PROC	1,552	1,164	1,164			3,879
PEAS: GREEN, PROC	5,477	4,108	4,108			13,693
PUMKIN & SQUASH: PROC	460	345	345			1,151
RADISHES			553			553
TOMATOES: PROC	16,548		11,032			27,580
	78,398	47,923	45,211	3,548	1,772	176,851

SOURCE: OMAF, SEASONAL FRUIT AND VEGETABLES

TABLE C3.1: AREA, YIELD AND PRODUCTION OF PRINCIPAL ONTARIO FIELD CROPS BY REGION. 1981-1986

	WINTER WHEAT			SPRING WHEAT[1]			OATS		
	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 bu)	Yield (bu/ac)
S 1981	335910	17197		5783	401		75744	4762	
S 1982	155000	6130		5776	130		95000	6065	
S 1983	368000	18716		6629	358		80000	3905	
S 1984	320000	18003		6345	254		60000	3846	
S 1985	313500	21282		6914	657		68000	4990	
S 1986	370027	19530		13414	436		69645	4129	
AVG.	310406	16810	54	7477	373	50	74732	4616	62
W 1981	105606	6006		4575	169		55750	3657	
W 1982	105000	5117		4554	233		100000	6709	
W 1983	137000	7447		7166	46		92500	4794	
W 1984	131000	8422		6296	212		86000	5866	
W 1985	145000	9970		8037	225		90500	6428	
W 1986	188663	10909		27936	839		59019	3958	
AVG.	135378	7979	59	9761	287	29	80628	5235	65
C 1981	54308	2444		2115	141		56611	2876	
C 1982	37000	1591		2109	157		55000	3138	
C 1983	51000	2095		2889	154		46000	1802	
C 1984	52000	2559		2629	212		44000	2443	
C 1985	56500	3259		3149	207		52500	3414	
C 1986	66372	3547		9092	643		49122	3050	
AVG.	52863	2583	49	3664	252	69	50539	2787	55
E 1981	8807	388		6293	121		96534	4150	
E 1982	3000	126		6283	245		80000	4306	
E 1983	8000	240		7492	320		74000	2937	
E 1984	7000	308		7089	304		75000	3879	
E 1985	9000	495		7894	318		78500	5128	
E 1986	15280	760		17098	881		60344	3546	
AVG.	8515	386	45	8692	365	42	77396	3991	52
N 1981	363	14		3282	50		41744	2038	
N 1982				3278	116		40000	2251	
N 1983	1000	25		3824	132		37500	1762	
N 1984				3642	139		35000	1955	
N 1985	1000	45		4006	123		30500	1551	
N 1986	1085	42		8164	300		23811	1153	
AVG.	862	32	37	4366	143	33	34759	1785	51
P 1981	504994	26049		22048	882		326383	17483	
P 1982	300000	12964		22000	880		370000	22469	
P 1983	565000	28523		28000	1010		330000	15200	
P 1984	510000	29292		26000	1120		300000	17989	
P 1985	525000	35051		30000	1530		320000	21511	
P 1986	641427	34788		75704	3100		261941	15836	
AVG.	507737	27778	55	33959	1420	42	318054	18415	58

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

TABLE C3.2: AREA, YIELD AND PRODUCTION OF PRINCIPAL ONTARIO FIELD CROPS BY REGION. 1981-1986

	BARLEY			MIXED GRAINS			RYE[2]		
	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 bu)	Yield (bu/ac)
S 1981	84922	5017		79224	5208		79564	2994	
S 1982	110000	6309		85000	5440		84216	2927	
S 1983	72000	3214		70000	3525		79752	2750	
S 1984	55000	3104		62500	4088		76181	2824	
S 1985	69500	4714		62500	4675		66361	2664	
S 1986	77655	4198		60102	3787		50013	1765	
AVG.	78180	4426	57	69888	4454	64	72681	2654	37
W 1981	227110	13997		509609	33490		4682	176	
W 1982	270000	16849		480000	31769		4801	196	
W 1983	260000	12737		452000	23375		4687	148	
W 1984	236000	15462		441000	30339		4596	193	
W 1985	269500	18566		405500	29104		4346	187	
W 1986	310584	19439		335721	21831		3929	135	
AVG.	262199	16175	62	437305	28318	65	4507	173	38
C 1981	51530	2845		90013	4963		4705	150	
C 1982	70000	4015		85000	5021		5203	170	
C 1983	66000	2656		80000	3311		4725	135	
C 1984	56500	3135		77500	4427		4343	139	
C 1985	57500	3730		78000	5178		3291	122	
C 1986	69370	4222		68441	4175		1540	44	
AVG.	61817	3434	56	79826	4513	57	3968	127	32
E 1981	66927	3177		73088	3428		566	0	
E 1982	85000	4738		65000	3666		514	21	
E 1983	79000	3193		66000	2801		564	20	
E 1984	75500	3863		60000	3071		604	23	
E 1985	76000	5032		56500	3713		715	17	
E 1986	99224	6027		53313	3174		899	28	
AVG.	80275	4338	54	62317	3309	53	644	18	28
N 1981	36113	1795		31377	1681		272	0	
N 1982	45000	2518		25000	1443		267	6	
N 1983	48000	2343		17000	774		272	7	
N 1984	52000	2683		19000	972		276	0	
N 1985	47500	2624		17500	896		287	9	
N 1986	45682	2406		16434	827		306	8	
AVG.	45716	2395	52	21052	1099	52	280	5	17
P 1981	466602	26831		783311	48770		89789	3320	
P 1982	580000	34429		740000	47339		95000	3320	
P 1983	525000	24143		685000	33786		90000	3060	
P 1984	475000	28247		660000	42897		86000	3180	
P 1985	520000	34666		620000	43566		75000	3000	
P 1986	602515	36292		534011	33794		56687	1980	
AVG.	528186	30768	58	670387	41692	62	82079	2977	36

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

TABLE C3.3: AREA, YIELD AND PRODUCTION OF PRINCIPAL ONTARIO FIELD CROPS BY REGION. 1981-1986

	BUCK WHEAT			SOYBEANS			FLAXSEED[3]
	Area[3] (acres)	Production[4] ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)
S 1981	1328	48		637634	20732		729
S 1982	1618	56		805000	28416		628
S 1983	1618	35		763000	22426		314
S 1984	925	20		849000	28845		245
S 1985	1040	28		874000	33313		173
S 1986	1624	26		791462	29582		265
AVG.	1359	36	26	786683	27219	35	392
W 1981	2865	135		29452	907		10081
W 1982	2213	151		55000	1645		18201
W 1983	2213	140		87000	2819		9100
W 1984	1264	101		121000	3655		7098
W 1985	1422	111		117000	3661		5005
W 1986	2221	121		105524	3378		7678
AVG.	2033	126	62	85829	2678	31	9527
C 1981	2681	27		15799	474		5
C 1982	1658	36		25000	675		
C 1983	1658	29		31000	775		
C 1984	947	20		38000	1140		
C 1985	1066	22		38500	1001		
C 1986	1664	26		28584	915		
AVG.	1612	27	17	29481	830	28	5
E 1981	5367	31		6142	184		25
E 1982	7983	42		15000	435		
E 1983	7983	35		19000	494		
E 1984	4562	25		22000	682		
E 1985	5132	30		20500	533		
E 1986	8013	37		14035	390		
AVG.	6506	33	5	16113	453	28	25
N 1981	651	17		34			283
N 1982	529	23					972
N 1983	529	26					486
N 1984	302	17					379
N 1985	340	16					267
N 1986	531	15		133	3		410
AVG.	480	19	39	84	3	36	466
P 1981	12892	258		689061	22297		11123
P 1982	14000	308		900000	31171		20000
P 1983	14000	266		900000	26514		10000
P 1984	8000	184		1030000	34322		7800
P 1985	9000	207		1050000	38508		5500
P 1986	14053	225	16	939738	34268		8437
AVG.	11991	241	20	918133	31180	34	10477

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

TABLE C3.4: AREA, YIELD AND PRODUCTION OF PRINCIPAL ONTARIO FIELD CROPS BY REGION. 1981-1986

	CANOLA[3]	GRAIN CORN			FODDER CORN		
	Area (acres)	Area (acres)	Production ('000 bu)	Yield (bu/ac)	Area (acres)	Production ('000 tons)	Yield/acre (tons)
S 1981	39	1121200	116576		151627	2192	
S 1982		1110000	114651		150000	1940	
S 1983	699	1065000	107370		150000	1911	
S 1984	1151	1168000	121622		132000	1795	
S 1985	2056	1186000	134717		127000	1805	
S 1986	3809	1001702	112467		115317	1575	
AVG.	1551	1108650	117901	106	137657	1870	14
W 1981	1746	621740	56205		270365	3737	
W 1982		560000	54705		255000	3349	
W 1983	13427	560000	50209		245000	2913	
W 1984	22115	612000	56200		233500	3076	
W 1985	39492	614000	58488		218500	2844	
W 1986	73163	477512	47341		193233	2584	
AVG.	29989	574209	53858	94	235933	3084	13
C 1981	177	254871	19997		83751	1000	
C 1982		240000	20703		80000	890	
C 1983	1714	225000	16147		76000	688	
C 1984	2823	247000	20381		71000	853	
C 1985	5042	246000	19349		67500	740	
C 1986	9340	169022	14703		64652	765	
AVG.	3819	230316	18547	81	73817	823	11
E 1981	29	173650	13342		133559	1591	
E 1982		170000	14452		130000	1514	
E 1983	485	150000	11148		125000	1286	
E 1984	800	173000	14020		120000	1447	
E 1985	1428	184000	15846		114000	1277	
E 1986	2645	180581	13500		93158	1047	
AVG.	1077	171872	13718	80	119286	1360	11
N 1981	144	316			3920	47	
N 1982					5000	52	
N 1983	674				4000	38	
N 1984	1111				3500	35	
N 1985	1983				3000	32	
N 1986	3674	403	18		3365	30	
AVG.	1517	360	18	50	3798	39	10
P 1981	2135	2171777	206120		643222	8567	
P 1982		2080000	204511		620000	7745	
P 1983	17000	2000000	184874		600000	6836	
P 1984	28000	2200000	212223		560000	7206	
P 1985	50000	2230000	228400		530000	6698	
P 1986	92631	1829220	188029		469725	6001	
AVG.	37953	2085166	204026	98	570491	7176	13

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

TABLE C3.5: AREA, YIELD AND PRODUCTION OF PRINCIPAL ONTARIO FIELD CROPS BY REGION, 1981-1986

	DRY WHITE BEANS			TOBACCO			HAY		
	Area (acres)	Production ('000 cwt)	Yield/acre (cwt)	Area (acres)	Production ('000 lb)	Yield/acre (lb)	Area (acres)	Production ('000 tons)	Yield/acre (tons)
S 1981	29000	352		116174	215637		322030	1172	
S 1982	26500	363		112932	152482		300000	1022	
S 1983	18500	225		98315	212820		300000	1070	
S 1984	20000	251		83626	167767		291000	1020	
S 1985	22000	315		82972	166569		288500	1051	
S 1986	21118	206		62910	128064		320851	1246	
AVG.	22853	285	12	92822	173890	1873	303730	1097	4
W 1981	81000	1073					855106	2720	
W 1982	83500	1134					850000	2835	
W 1983	49500	625					850000	2652	
W 1984	55000	743					846000	2768	
W 1985	68000	975					856000	2733	
W 1986	84016	684		145	296		817893	3075	
AVG.	70169	872	12	145	296	2041	845833	2797	3
C 1981				4249	7433		444003	1318	
C 1982				4200	6046		445000	1264	
C 1983				3500	5904		450000	1237	
C 1984				2900	5267		453000	1339	
C 1985				2800	4855		457000	1262	
C 1986	2065	22		1632	2990		437111	1460	
AVG.	2065	22	11	3214	5416	1685	447686	1313	3
E 1981							680699	1916	
E 1982							680000	1856	
E 1983							700000	1831	
E 1984							706000	2025	
E 1985							709000	2166	
E 1986	276	2					645822	2056	
AVG.	276	2	7	0	0	0	686920	1975	3
N 1981							273281	639	
N 1982							265000	657	
N 1983							270000	612	
N 1984							274000	691	
N 1985							279500	658	
N 1986							251403	567	
AVG.	0	0	0	0	0	0	268864	637	2
P 1981	110000	1425		120423	223070		2575119	7765	
P 1982	110000	1497		117132	158528		2540000	7634	
P 1983	68000	850		101815	218724		2570000	7402	
P 1984	75000	994		86526	173034		2570000	7843	
P 1985	90000	1290		85772	171424		2590000	7870	
P 1986	107475	914		64687	131350		2473080	8404	
AVG.	93413	1162	12	96059	179355	1867	2553033	7820	3

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

Footnotes

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1. The intercensal values (1982 to 1985) for the regional spring wheat area are the result of the distribution of the provincial crop area to the regional levels, using the following formula:

$$RA_t = RA_{t-1} (PA_t - PA_{t-1}) * \frac{RA_{1986} - RA_{1981}}{PA_{1986} - PA_{1981}}$$

where:

RA_t = area in the corresponding region (South, West, Central, East and North) for the intercensal year t,

PA = area in Ontario province,

1981 and 1986 are the census values.

The intercensal crop production estimates by region for spring wheat have been calculated using the yearly information on yields for all wheat; these were taken from the Yield Survey, conducted jointly by Statistics Canada and OMAF. We use the following formula to derive regional production (RP) values from the OMAF provincial values:

RP_t = {[(RA_t winter wheat area + RA_t spring wheat area) * (RY_t all wheat yield - RP_t winter wheat production)] / [PP_t all wheat production - PP_t winter wheat production]}

* PP_t spring wheat production

where: RY = yields in the corresponding region

2. The intercensal estimates for crop area and production of Rye have been calculated using the same method explained in Note 1 for the obtention of spring wheat area and production.

3. The 1982 to 1985 regional crop area estimates for buckwheat, flaxseed and canola have been obtaining using the regional proportions corresponding to the 1986 census values:

$$RA_t = (RA_{1986} / PA_{1986}) * PA_t$$

4. The 1982 to 1985 regional crop production estimates for buckwheat have been calculated applying the proportional regional distribution of barley production to the provincial buckwheat production values.

TABLE C4:PROPORTION OF ONTARIO CROPLAND PLANTED TO VARIOUS CROPS BY REGION, 1981-86.

	ALL WHEAT	COARSE GRAINS	SOY	GRAIN CORN	FODDER CORN	OTHER CROPS
SOUTH						
1981	0.120	0.113	0.224	0.394	0.053	0.096
1982	0.056	0.131	0.280	0.387	0.052	0.094
1983	0.129	0.105	0.263	0.368	0.052	0.083
1984	0.110	0.086	0.286	0.394	0.045	0.079
1985	0.106	0.089	0.290	0.393	0.042	0.080
1986	0.138	0.093	0.286	0.362	0.042	0.079
AVG.82-86	0.108	0.101	0.281	0.381	0.046	0.083
WEST						
1981	0.056	0.403	0.015	0.313	0.136	0.077
1982	0.055	0.428	0.027	0.280	0.127	0.083
1983	0.073	0.410	0.044	0.283	0.124	0.066
1984	0.068	0.381	0.060	0.303	0.116	0.072
1985	0.075	0.377	0.057	0.300	0.107	0.084
1986	0.112	0.369	0.055	0.248	0.100	0.116
AVG.82-86	0.076	0.393	0.049	0.283	0.115	0.084
CENTRAL						
1981	0.084	0.307	0.024	0.381	0.125	0.079
1982	0.060	0.330	0.038	0.365	0.122	0.085
1983	0.084	0.310	0.049	0.352	0.119	0.086
1984	0.084	0.280	0.058	0.378	0.109	0.091
1985	0.090	0.289	0.058	0.370	0.102	0.091
1986	0.127	0.321	0.048	0.285	0.109	0.110
AVG.82-86	0.088	0.306	0.050	0.351	0.112	0.092
EAST						
1981	0.026	0.422	0.011	0.302	0.232	0.007
1982	0.016	0.420	0.026	0.300	0.229	0.009
1983	0.029	0.420	0.035	0.277	0.231	0.008
1984	0.026	0.392	0.040	0.314	0.218	0.010
1985	0.030	0.389	0.037	0.330	0.204	0.010
1986	0.059	0.403	0.026	0.328	0.169	0.015
AVG.82-86	0.032	0.405	0.033	0.310	0.210	0.010
NORTH						
1981	0.030	0.918	0.000	0.003	0.033	0.016
1982	0.027	0.909	0.000	0.000	0.041	0.023
1983	0.042	0.898	0.000	0.000	0.035	0.025
1984	0.031	0.912	0.000	0.000	0.030	0.027
1985	0.046	0.887	0.000	0.000	0.028	0.039
1986	0.087	0.819	0.001	0.004	0.032	0.057
AVG.82-86	0.046	0.887	0.001	0.004	0.033	0.033

SOURCE: ESTIMATIONS

TABLE C5: ONTARIO AREA IN ACRES OF FARM LAND BY REGIONS

(1981)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
UNDERCROPS	3285877	2879164	1129468	1279693	402462	8976664
SUMMER FALLOW	44112	40296	31451	26691	13890	156440
OTHER	121989	114140	72858	70266	29724	408977
TAME HAY	322030	855106	444003	680699	273281	2575119
CROPLAND*	2963847	2024058	685465	598994	129181	6401545
IMPROVED PASTURE	197698	557895	301086	417956	148871	1623506
UNIMPROVED LAND AREA	430315	803333	844871	1056868	622041	3757428

(1986)

	SOUTH	WEST	CENTRAL	EAST	NORTH	PROVINCE
UNDERCROPS	3175629	2767393	1032007	1206281	363510	8544820
SUMMER FALLOW	73891	49019	38412	23971	13224	198517
OTHER	97458	91151	50937	52207	18511	310264
TAME HAY	320851	817893	437111	645822	251403	2473080
CROPLAND*	2854778	1949500	594896	560459	112107	6071740
IMPROVED PASTURE	134096	394607	189153	248349	99526	1065731
UNIMPROVED LAND AREA	449636	861299	857439	1065727	599576	3833677

*CROPLAND = UNDERCROPS-TAME HAY

SOURCE: OMAF, AGRICULTURAL STATISTICS FOR ONTARIO

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